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ABSTRACT

This report traces current environmental trends and assesses the adequacy of natural resources to fulfill human and economic needs. It reviews programs and activities of federal, state, and local governments and nongovernment entities or individuals, detailing effects on the environment. Ways are suggested for remedying the deficiencies of existing programs and activities. Major sections of the publication are: (1) Understanding Environmental Problems; (2) Federal Organization for Environmental Quality; (3) Water Pollution; (4) Air Pollution; (5) Man's Inadvertent Modification of Weather and Climate; (6) Solid Wastes; (7) Noise, Pesticides, and Radiation; (8) Population, Growth and Resources; (9) Land Use; (10) International Cooperation; (11) Citizen Participation; (12) Environmental Education; and (13) Present and Future Environmental Needs. Appendices include a number of Presidential messages and legislative acts related to the environment. (Author/CP)

ED 062109

Environmental Quality

The First Annual Report of the Council on Environmental Quality

Transmitted to the Congress
August 1970

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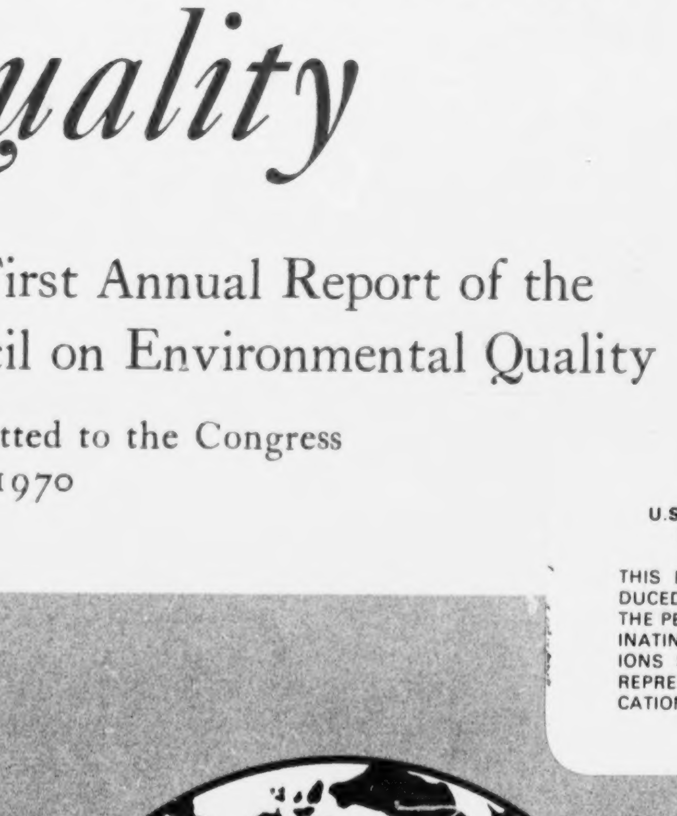

SE 012 624

Environmental Quality

THE FIRST ANNUAL REPORT
of the
COUNCIL ON ENVIRONMENTAL QUALITY

together with
THE PRESIDENT'S MESSAGE TO CONGRESS

TRANSMITTED TO THE CONGRESS
AUGUST 1970

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President's Message

President's Message

To the Congress of the United States:

This first report to the Congress on the state of the Nation's environment is an historic milestone. It represents the first time in the history of nations that a people has paused, consciously and systematically, to take comprehensive stock of the quality of its surroundings.

It comes not a moment too soon. The recent upsurge of public concern over environmental questions reflects a belated recognition that man has been too cavalier in his relations with nature. Unless we arrest the depredations that have been inflicted so carelessly on our natural systems—which exist in an intricate set of balances—we face the prospect of ecological disaster.

The hopeful side is that such a prospect *can* be avoided. Although recognition of the danger has come late, it has come forcefully. There still are large gaps in our environmental knowledge, but a great deal of what needs to be done can be identified. Much of this has already been begun, and much more can be started quickly if we act now.

Scope of the Council's Report

The accompanying report by the Council on Environmental Quality seeks to describe the conditions of our environment, and to identify major trends, problems, actions under way and opportunities for the future. This first report by the Council is necessarily incomplete in some respects, especially in the identification of trends. The National Environmental Policy Act, which created the Council, became law only at the beginning of this year. Existing systems for measuring and monitoring environmental conditions and trends, and for developing indicators of environmental quality, are still inadequate. There also is a great deal yet to be learned about the significance of these facts for the human condition.

However, the report will, I think, be of great value to the Congress (and also to the Executive Branch) by assembling in one comprehensive document a wealth of facts, analyses and recommendations concerning a wide range of our most pressing environmental challenges. It should also serve a major educational purpose, by clarifying for a broad public what those challenges are and where the principal dangers and opportunities lie.

Substantively as well as historically, this first report is an important document. No one can read it and remain complacent about the environmental threats we confront, or about the need both to do more and to learn more about those threats.

Getting at the Roots

"Environment" is not an abstract concern, or simply a matter of esthetics, or of personal taste—although it can and should involve these as well. Man is shaped to a great extent by his surroundings. Our physical nature, our mental health, our culture and institutions, our opportunities for challenge and fulfillment, our very survival—all of these are directly related to and affected by the environment in which we live. They depend upon the continued healthy functioning of the natural systems of the Earth.

Environmental deterioration is not a new phenomenon. But both the rate of deterioration and its critical impact have risen sharply in the years since the Second World War. Rapid population increases here and abroad, urbanization, the technology explosion and the patterns of economic growth have all contributed to our environmental crisis. While growth has brought extraordinary benefits, it has not been accompanied by sufficiently foresighted efforts to guide its development.

At the same time, in many localities determined action has brought positive improvements in the quality of air or water—demonstrating that, if we have the will and make the effort, we can meet environmental goals. We also have made important beginnings in developing the institutions and processes upon which any fundamental, long-range environmental improvement must be based.

The basic causes of our environmental troubles are complex and deeply imbedded. They include: our past tendency to emphasize quantitative growth at the expense of qualitative growth; the failure of our economy to provide full accounting for the social costs of environmental pollution; the failure to take environmental factors into account as a normal and necessary part of our planning and decision-making; the inadequacy of our institutions for dealing with problems that cut across traditional political boundaries; our dependence on conveniences, without regard for their impact on the environment; and more fundamentally, our failure to perceive the environment as a totality and to understand and to recognize the fundamental interdependence of all its parts, including man himself.

It should be obvious that we cannot correct such deep-rooted causes overnight. Nor can we simply legislate them away. We need new knowledge, new perceptions, new attitudes—and these must extend to all levels of government and throughout the private sector as well: to industry; to the professions; to each individual citizen in his job and in his home. We must seek nothing less than a basic reform in the way our society looks at problems and makes decisions.

Our educational system has a key role to play in bringing about this reform. We must train professional environmental managers to deal with pollution, land planning, and all the other technical requirements of a high quality environment. It is also vital that our entire society develop a new understanding and a new awareness of man's relation to his environment—what might be called "environmental literacy." This will require the development and teaching of environmental concepts at every point in the educational process.

While education may provide ultimate answers to long-range environmental problems, however, we cannot afford to defer reforms which are needed now. We have already begun to provide the institutional framework for effective environmental improvement.

Organizing for Improvement

As my first official act of the decade, on January first I signed into law the National Environmental Policy Act. That Act established the Council on Environmental Quality. I have charged the Council with coordinating all environmental quality programs and with making a thorough review of all other Federal programs which affect the environment.

Federal agencies are now required to file with the Council and the public a statement setting out in detail the environmental implications of all proposals for legislation and for other major activities with a significant environmental impact. With the help of this provision, I intend to ensure that environmental considerations are taken into account at the earliest possible stage of the decision-making process.

On July 9 I sent to the Congress a reorganization plan which would establish an Environmental Protection Agency, consolidating the major environmental pollution responsibilities of the Federal Government. This reform is long overdue.

Responsibility for anti-pollution and related programs is now fragmented among several Departments and agencies, thus weakening our overall Federal effort. Air pollution, water pollution and solid wastes are different forms of a single problem, and it becomes increasingly evident that broad systems approaches are going to be needed to bring our pollution problems under control. The reorganization would give unified direction to our war on pollution and provide a stronger organizational base for our stepped-up effort.

The Council on Environmental Quality has begun the vital task of identifying indicators of environmental quality and determining the requirements for monitoring systems in order to enable us to assess environmental trends. These systems are needed to give early warning of environmental problems. They will provide data for determining environmental needs and establishing priorities, and for assessing the effectiveness of programs to improve the environment. The development of such monitoring systems is essential to effective environmental management.

There is also a need to develop new knowledge through research. We need to know far more, for example, about the effects of specific pollutants, about ecological relationships, and about human behavior in relation to environmental factors. The Environmental Protection Agency should develop an integrated research program aimed at pollution control. The Council on Environmental Quality will continue, in cooperation with the Office of Science and Technology, to review and coordinate our overall environmental research effort, as well as to undertake its own environmental studies and research.

These actions represent important additions to the institutional, procedural, and informational base for effective environmental management. They hold the promise of a real leap forward in the years to come. At the same time, we must move ahead now in those areas in which we already possess the knowledge and capability for effective action.

Recent Actions and Recommendations

On February 10 of this year, I sent to the Congress a special message on the environment. This presented a 37-point action program, with special emphasis on strengthening our fight against water and air pollution.

In the field of water pollution, my major legislative recommendations included:

- —Authorization of $4 billion to cover the Federal share of a $10 billion program to provide treatment facilities.
- —Establishment of an Environmental Financing Authority to help finance the State and local share of treatment plants.
- —Reform of the method by which funds are allocated under the treatment grant programs.
- —Greatly strengthened enforcement authority, including provisions for fines of up to $10,000 a day for violations.

Among my major legislative recommendations for the control of air pollution were:

- —More stringent procedures for reducing pollution from motor vehicles.
- —Establishment of national air quality standards.
- —Establishment of national emissions standards for extremely hazardous pollutants.
- —A major strengthening of enforcement procedures, including extension of Federal air pollution control authority to both inter- and intra-state situations and provision for fines of up to $10,000 a day for violators.

Other legislative actions recommended in my February 10 message included:

- —Appropriation in 1971 of the full $327 million authorized under the Land and Water Conservation Fund to provide additional parks and recreation areas, with increased emphasis on locating new recreation facilities in crowded urban areas.

—Establishment of new procedures to encourage and finance the relocation of Federal facilities now occupying land that could better be turned to public recreational use

—Authorizing the transfer of surplus real property to State and local governments for park and recreational purposes at public benefit discounts of up to 100 percent.

In addition, the message spelled out 14 separate measures I was taking by administrative action or Executive Order. These included such wide-ranging initiatives as launching an extensive Federal research and development program in unconventionally-powered, low-pollution vehicles, requiring the development of comprehensive river basin plans for water pollution control, re-directing research on solid waste management to place greater emphasis on re-cycling and re-use, and the establishment of a Property Review Board to recommend specific Federal properties for conversion to recreational use.

I again urge the Congress to act soon and favorably on the legislative proposals contained in that message. They are vital to our growing effort to protect and improve our environment.

I consider the recommendations in my February 10 message only a beginning—although an important one. I said at the time that we must do much more and that we would do more as we gained experience and knowledge. Our Administration is living up to that commitment.

Previously, on February 4, I had issued an Executive Order directing a prompt clean-up of air and water pollution caused by Federal agencies. This task is well underway. As I said then, the Federal Government should set an example for the rest of the country. We are doing so.

On April 15, I sent legislation to the Congress that will, if enacted, bring to an end the dumping of dredged spoils into the Great Lakes as soon as disposal sites are available. At the same time, I directed the Council on Environmental Quality to make a study of ocean disposal of wastes and report to me by September 1.

On May 19, I proposed enactment of a special tax on lead additives in gasoline, to encourage industry to provide low or non-leaded gasoline.

On May 20, I sent to the Congress a special message dealing with oil pollution caused by marine transportation of oil. The comprehensive, 10-point program set out in the message included legislative proposals, the announcement of administrative actions, and the forwarding to the Senate of two international conventions and amendments to a third for ratification. The nations of the world must take aggressive action to end the growing pollution of the oceans.

On May 23, I announced that the United States would propose a new treaty placing the natural resources of the deep sea bed beyond the 200 meter depth under international regulation.

On June 4, a revised National Contingency Plan for dealing with oil spills was announced at my direction by the Chairman of the Council on Environmental Quality.

On June 11, I sent a message to the Congress requesting the enactment of legislation cancelling twenty Federal oil leases for off-shore drilling which had been granted in 1968 in the Santa Barbara Channel and creating a Marine Sanctuary.

As I mentioned above, on July 9 I sent to the Congress a reorganization plan to create a new Environmental Protection Agency. On the same date, I sent another reorganization plan to consolidate Federal marine resource management functions in a National Oceanic and Atmospheric Administration, within the Department of Commerce. This would provide better coordination and direction of our vital ocean resource programs.

Toward A Land Use Policy

Lately, our attention as a people has repeatedly and insistently been seized by urgent concerns and immediate crises: by the sudden blanketing of cities or even whole regions with dense clouds of smog, for example, or the discovery of mercury pollution in rivers. But as we take the longer view, we find another challenge looming large: the mounting pressures of population. Both the size and the distribution of our population have critical relevance to the quality of our environment and thus to the quality of our lives.

Population growth poses an urgent problem of global dimensions. If the United States is to have an effective voice in world population policies, it must demonstrate willingness to face its own population problems at home.

The particular impact of any given level of population growth depends in large measure on patterns of land use. Three quarters of our people now live in urban areas, and if present trends continue most of them in the future will live in a few mammoth urban concentrations. These concentrations put enormous pressure on transportation, sanitation and other public services. They sometimes create demands that exceed the resource capacity of the region, as in the case of water supply. They can aggravate pollution, overcrowd recreation facilities, limit open space, and make the restorative world of nature ever more remote from everyday life. Yet we would be blind not to recognize that for the most part the movement of people to the cities has been the result neither of perversity nor of happenstance, but rather of natural human aspirations for the better jobs, schools, medical services, cultural opportunities and excitement that have traditionally been associated with urban life.

If the aspirations which have drawn Americans to the city in the first instance and subsequently from the city core to the suburbs are often proving illusory, the solution does not lie in seeking escape from urban life. Our challenge is to find ways to promote the amenities of life in the midst of urban development: in short, to make urban life fulfilling rather than frustrating. Along with the essentials of jobs and housing, we must also provide open spaces and outdoor recreation opportunities, maintain acceptable levels of air and water quality, reduce noise and litter, and develop cityscapes that delight the eye and uplift the spirit.

By the same token, it is essential that we also make rural life itself more attractive, thus encouraging orderly growth in rural areas. The creation of greater economic, social, cultural, and recreational opportunities in rural parts of the country will lead to the strengthening of small cities and towns, contributing to the establishment of new growth centers in the nation's heartland region.

Throughout the nation there is a critical need for more effective land use planning, and for better controls over use of the land and the living systems that depend on it. Throughout our history, our greatest resource has been our land—forests and plains, mountains and marshlands, rivers and lakes. Our land has sustained us. It has given us a love of freedom, a sense of security, and courage to test the unknown.

We have treated our land as if it were a limitless resource. Traditionally, Americans have felt that what they do with their own land is their own business. This attitude has been a natural outgrowth of the pioneer spirit. Today, we are coming to realize that our land is finite, while our population is growing. The uses to which our generation puts the land can either expand or severely limit the choices our children will have. The time has come when we must accept the idea that none of us has a right to abuse the land, and that on the contrary society as a whole has a legitimate interest in proper land use. There is a national interest in effective land use planning all across the nation.

I believe that the problems of urbanization which I have described, of resource management, and of land and water use generally can only be met by comprehensive approaches which take into account the widest range of social, economic, and ecological concerns. I believe we must work toward development of a National Land Use Policy to be carried out by an effective partnership of Federal, State and local governments together, and, where appropriate, with new regional institutional arrangements.

Recycling of Wastes

The prospect of increasing population density adds urgency to the need for greater emphasis on recycling of "waste" products. More people means greater consumption—and thus more rapid depletion—of scarce natural resources; greater consumption means more "waste" to dispose of—whether in the form of solid wastes, or of the pollutants that foul our air and water.

Yet much of this waste is unnecessary. Essentially, waste is a human invention: Natural systems are generally "closed" systems. Energy is transformed into vegetation, vegetation into animal life, and the latter returns to the air and soil to be recycled once again. Man, on the other hand, has developed "open" systems—ending all too often in an open sewer or an open dump.

We can no longer afford the indiscriminate waste of our natural resources; neither should we accept as inevitable the mounting costs of waste removal. We must move increasingly toward closed systems that recycle what now are considered wastes back into useful and productive purposes. This poses a major challenge—and a major opportunity—for private industry. The Council on Environmental Quality is working to foster development of such systems. Establishment of the proposed Environmental Protection Agency would greatly increase our ability to address this need systematically and creatively.

Everyone's Task

As our government has moved ahead to improve our environmental management, it has been greatly heartening to me to see the extent and effectiveness of citizen concern and activity, and especially the commitment of young people to the task. The job of building a better environment is not one for government alone. It must engage the enthusiasm and commitment of our entire society. Citizen organizations have been in the forefront of action to support strengthened environmental programs. The Citizens Advisory Committee on Environmental Quality, under the chairmanship of Laurance S. Rockefeller, has provided an important link between the Federal Government's effort and this broad-ranging citizen activity.

Similarly, the active participation of the business community is essential. The government's regulation and enforcement activities will continue to be strengthened. Performance standards must be upgraded as rapidly as feasible. But regulation cannot do the whole job. Forward-looking initiatives by business itself are also vital—in research, in the development of new products and processes, in continuing and increased investment in pollution abatement equipment.

On the international front, the level of environmental concern and action has been rapidly rising. Many of our most pressing environmental problems know no political boundaries. Environmental monitoring and pollution of the seas are examples of major needs that require international cooperation, and that also provide an opportunity for the world's nations to work together for their common benefit.

In dealing with the environment we must learn not how to master nature but how to master ourselves, our institutions, and our technology. We must achieve a new awareness of our dependence on our surroundings and on the natural systems which support all life, but awareness must be coupled with a full realization of our enormous capability to alter these surroundings. Nowhere is this capability greater than in the United States, and this country must lead the way in showing that our human and technological resources can be devoted to a better life and an improved environment for ourselves and our inheritors on this planet.

Our environmental problems are very serious, indeed urgent, but they do not justify either panic or hysteria. The problems are highly complex, and their resolution will require rational, systematic approaches, hard work and patience. There must be a *national* commitment and a *rational* commitment.

The accompanying report by the Council describes the principal problems we face now and can expect to face in the future, and it provides us with perceptive guidelines for meeting them. These deserve the most careful consideration. They point the directions in which we must move as rapidly as circumstances permit.

The newly aroused concern with our natural environment embraces old and young alike, in all walks of life. For the young, it has a special urgency. They know that it involves not only our own lives now but the future of mankind. For their parents, it has a special poignancy—because ours is the first generation to feel the pangs of concern for the environmental legacy we leave to our children.

At the heart of this concern for the environment lies our concern for the human condition: for the welfare of man himself, now and in the future. As we look ahead to the end of this new decade of heightened environmental awareness, therefore, we should set ourselves a higher goal than merely remedying the damage wrought in decades past. We should strive for an environment that not only sustains life but enriches life, harmonizing the works of man and nature for the greater good of all.

Richard Nixon

The White House, *August 1970.*

The First Annual Report
# of the
Council on Environmental Quality

EXECUTIVE OFFICE OF THE PRESIDENT
COUNCIL ON ENVIRONMENTAL QUALITY
722 JACKSON PLACE, N. W.
WASHINGTON, D. C. 20006

August 3, 1970

LETTER OF TRANSMITTAL

THE PRESIDENT:

Sir: The Council on Environmental Quality herewith submits its first Annual Environmental Quality Report, August 1970, in accordance with Section 201 of the National Environmental Policy Act of 1969.

Respectfully,

Russell E. Train
Russell E. Train
Chairman

Robert Cahn
Robert Cahn

Gordon J MacDonald
Gordon J. MacDonald

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WHEN President Nixon, as his first official act of the new decade, signed the National Environmental Policy Act, he declared that improving the quality of the environment is a major goal for the Nation and that, "unless we move on it now, we will not have an opportunity to do it later."

The new Act, which established the Council on Environmental Quality in the Executive Office of the President, included the provision that the President shall transmit to the Congress annually an Environmental Quality Report setting forth the status and condition of the Nation's environment. According to section 201 of the act (Public Law 91–190), the report shall trace current environmental trends and the adequacy of natural resources to fulfill human and economic needs. It shall review programs and activities of Federal, State, and local governments and of nongovernment entities or individuals, detailing the effects on the environment. And it shall suggest ways of remedying the deficiencies of existing programs and activities.

With less than one-quarter of the year available in which to prepare this first annual report, and with insufficient environmental quality indicators or systems by which to monitor the environment with any degree of accuracy, the Council has undertaken to bring together a description of environmental problems and issues facing the Nation.

While this report is wide ranging, the Council realizes that it is incomplete and uneven in some respects. Most important, the lack of measurement tools prevents an assessment at this time of the status and trends of the major environmental classes of the Nation. The Council has been able to give little or no detailed attention to subject areas such as the activities of State and local governments and of industry and has had an inadequate opportunity to analyze and report on areas such as the supply of natural resources. The Council expects to correct such major deficiencies in subsequent reports.

In preparing this report, the Council has also kept in mind the findings of Congress in the Environmental Quality Improvement Act of 1970 (Public Law 91–224) : "that man has caused changes in the environment; that many of these changes may affect the relationship between man and his environment; and that population increases and urban concentration contribute directly to pollution and the degradation of our environment." That act authorized the establishment of an Office of Environmental Quality which provides additional professional and administrative staff for and is meshed with the Council on Environmental Quality, so that the President has one advisory voice on environmental policy. The added personnel assist in preparing the annual report, assessing all other Federal programs that affect the environment, and implementing other requirements of Public Laws 91–190 and 91–224.

Much can be done now to enhance environmental quality, and this first annual report includes a number of specific suggestions for action. For the more distant future, however, environmental improvement will depend increasingly on knowledge yet to be obtained through research and measurement. Also needed will be refinements in predictions, setting of priorities, development of comprehensive policies and strategies, and strengthening of institutions at all levels of government. Responsibility for enhancing the environment cannot be thrust on any one level of government or even on government alone. Every citizen shares in it. Federal leadership, however, will necessarily be a major influence on the effectiveness of the overall national environmental effort.

The opening chapter of the report deals with the growing awareness and understanding by the American people of the nature of the threat to the environment and the interrelationship of environmental problems. Pollution is one of the most obvious dangers. But the problems are much broader. They encompass control of land use, the expansion of population, and waste of resources. The causes of many of our environmental problems rest with the failure of our price structure to take full account of environmental degradation, our values and our urge for greater mobility.

The effects, sources, and costs of various forms of pollution, and Federal, State, and local antipollution programs are then described. These chapters deal with pollution of air and water and pollution from solid wastes, pesticides, radiation, and noise. The pressures on the environment are then discussed in a chapter on population, economic growth, and resources. In the next chapter, the problem of land use is approached through analysis of its components—urban, suburban, rural, coastal, and natural regions, and the Federal programs that affect them. The chapter on international cooperation discusses environmental problems which do not stop at national frontiers, and the tools for international action. The growing involvement of citizens in environmental affairs, as individuals and through organizations, is followed by a review of the progress in environmental education. The concluding chapter discusses the need for better, stronger institutions, improved measurement of the environment, and the need for comprehensive policies and strategies. Like any first step, this first annual report is only a beginning.

I

Understanding Environmental Problems

Historians may one day call 1970 the year of the environment. They may not be able to say that 1970 actually marked a significant change for the better in the quality of life; in the polluting and the fouling of the land, the water, and the air; or in health, working conditions, and recreational opportunity. Indeed, they are almost certain to see evidence of worsening environmental conditions in many parts of the country.

Yet 1970 marks the beginning of a new emphasis on the environment—a turning point, a year when the quality of life has become more than a phrase; environment and pollution have become everyday words; and ecology has become almost a religion to some of the young. Environmental problems, standing for many years on the threshold of national prominence, are now at the center of nationwide concern. Action to improve the environment has been launched by government at all levels. And private groups, industry, and individuals have joined the attack.

No one can say for sure just how or why the environment burst into national prominence in 1970. Certainly national concern had been mounting for a long time, and the tempo has increased greatly in the last decade.

Early environmentalists—Henry David Thoreau, George Perkins Marsh, John Muir, Gifford Pinchot, Theodore Roosevelt, Aldo Leopold—and a legion of dedicated citizens contributed to the rise in awareness. In its early days, the conservation movement aimed primarily at stemming the exploitation of natural resources and preserving wildlife and important natural areas. By the 1950's, Federal air and water pollution laws had been enacted, and the pace of environmental legislation quickened dramatically in the decade of the 1960's. Now the conservation movement has broadened to embrace concern for the totality of man's environment, focusing on pollution, population, ecology, and the urban environment.

The public has begun to realize the interrelationship of all living things—including man—with the environment. The Santa Barbara oil spill in early 1969 showed an entire nation how one accident could temporarily blight a large area. Since then, each environmental issue—the jetport project near Everglades National Park, the proposed pipeline across the Alaskan wilderness, the worsening blight of Lake Erie, the polluted beaches off New York and other cities, smog in mile-high Denver, lead in gasoline, phosphates in detergents, and DDT—flashed the sign to Americans that the problems are everywhere and affect everyone. Millions of citizens have come to realize that the interdependent web of life—man, animals, plants, earth, air, water, and sunlight—touches everyone.

A deteriorating environment has awakened a lively curiosity in Americans about exactly what is meant by an ecosystem, a biome, or the biosphere. Citizens who are now aware of environmental problems want to know the full extent of the environmental crisis and the nature of the factors that have contributed to it. They are anxious to learn what can be done to correct the mistakes that have led to the current condition of the environment. This report attempts to answer some of these questions.

ECOLOGY AND CHANGE

Ecology is the science of the intricate web of relationships between living organisms and their living and nonliving surroundings. These interdependent living and nonliving parts make up *ecosystems*. Forests, lakes, and estuaries are examples. Larger ecosystems or combinations of ecosystems, which occur in similar climates and share a similar character and arrangement of vegetation, are *biomes*. The

Arctic tundra, prairie grasslands, and the desert are examples. The earth, its surrounding envelope of life-giving water and air, and all its living things comprise the *biosphere*. Finally, man's total *environmental system* includes not only the biosphere but also his interactions with his natural and manmade surroundings.

Changes in ecosystems occur continuously. Myriad interactions take place at every moment of the day as plants and animals respond to variations in their surroundings and to each other. Evolution has produced for each species, including man, a genetic composition that limits how far that species can go in adjusting to sudden changes in its surroundings. But within these limits the several thousand species in an ecosystem, or for that matter, the millions in the biosphere, continuously adjust to outside stimuli. Since interactions are so numerous, they form long chains of reactions. Thus small changes in one part of an ecosystem are likely to be felt and compensated for eventually throughout the system.

Dramatic examples of change can be seen where man has altered the course of nature. It is vividly evident in his well-intentioned but poorly thought out tampering with river and lake ecosystems. The Aswan Dam was primarily built to generate electric power. It produced power, but it also reduced the fish population in the Mediterranean, increased the numbers of disease-bearing aquatic snails, and markedly lowered the fertility of the Nile Valley.

In the United States, the St. Lawrence Seaway has contributed significantly to the economic growth of the Great Lakes region. Yet it has done so at a high and largely unforeseen cost to the environment. The completion of the Welland Canal let the predatory sea lamprey into the Great Lakes. Trout, which had been the backbone of the lakes' fishing industry, suffered greatly from the lamprey invasion. By the mid-1950's the trout and some other large, commercial predatory fish were nearly extinct. And with their near extinction, smaller fish, especially the alewife, normally kept under control by these predators, proliferated. The aggressive alewife dominated the food supply and greatly reduced the numbers of small remaining native fish, such as the lake herring. The alewife became so numerous, in fact, that on occasion great numbers died and the dead fish along the shore caused a major public nuisance.

Man attempted to restore the ecological balance by instituting sea lamprey control in the 1950's and 1960's and by stocking the lakes with coho salmon beginning in 1965—to replace the lost native predatory fish. Feeding on the abundant alewife, the salmon multiplied rapidly and by 1969 had become important both as a commercial and sport resource. Some of the salmon, however, were contaminated by excessive concentrations of DDT and were taken off the commercial market.

The lesson is not that such activities as the St. Lawrence Seaway must be halted, but that the consequences of construction must be carefully studied in advance of construction. Planners and managers must begin to appreciate the enormous interrelated complexity of environmental systems, weigh the tradeoffs of potential environmental harm against the benefits of construction, look at alternatives, and incorporate environmental safeguards into the basic design of new developments.

The stability of a particular ecosystem depends on its diversity The more interdependencies in an ecosystem, the greater the chances that it will be able to compensate for changes imposed upon it. A complex tropical forest with a rich mosaic of interdependencies possesses much more stability than the limited plant and animal life found on the Arctic tundra, where instability triggers frequent, violent fluctuations in some animal populations, such as lemmings and foxes. The least stable systems are the single crops—called monocultures—created by man. A cornfield or lawn has little natural stability. If they are not constantly and carefully cultivated, they will not remain cornfields or lawns but will soon be overgrown with a wide variety of hardier plants constituting a more stable ecosystem.

The chemical elements that make up living systems also depend on complex, diverse sources to prevent cyclic shortages or oversupply. The oxygen cycle, which is crucial to survival, depends upon a vast variety of green plants, notably plankton in the ocean. Similar diversity is essential for the continued functioning of the cycle by which atmospheric nitrogen is made available to allow life to exist. This cycle depends on a wide variety of organisms, including soil bacteria and fungi, which are often destroyed by persistent pesticides in the soil.

TYPES OF PROBLEMS

Pollution

Although pollution may be the most prominent and immediately pressing environmental concern, it is only one facet of the many-sided environmental problem. It is a highly visible, sometimes dangerous sign of environmental deterioration. Pollution occurs when materials accumulate where they are not wanted. Overburdened natural processes cannot quickly adjust to the heavy load of materials which man, or sometimes nature, adds to them. Pollution threatens natural systems, human health, and esthetic sensibilities; it often represents valuable resources out of place. DDT, for instance, is a valuable weapon in combating malaria. But DDT, when out of place—for example in lakes and streams—concentrates in fish, other wildlife, and the smaller living things on which they depend.

Historically, man has assumed that the land, water, and air around him would absorb his waste products. The ocean, the atmosphere, and even the earth were viewed as receptacles of infinite capacity. It is clear now that man may be exceeding nature's capacity to assimilate his wastes.

Most pollutants eventually decompose and diffuse throughout the environment. When organic substances are discarded, they are attacked by bacteria and decompose through oxidation. They simply rot. However, some synthetic products of our advanced technology resist natural decomposition. Plastics, some cans and bottles, and various persistent pesticides fall into this category. Many of these materials are toxic, posing a serious health danger.

Some pollutants, which may be thinly spread throughout the environment, tend to reconcentrate in natural food chains. Pesticides tend to diffuse in ocean water. The physical effects of 1 pound of a well-mixed pesticide in 10 billion pounds of water may seem negligible. But many sea animals filter out particular kinds of chemical compounds, including pesticides, and collect them in certain parts of their bodies at concentrations far higher than in the water in which they live. Algae may concentrate some component of a pesticide which is then concentrated further in the fish that eat the algae. In turn, still further concentrations may occur in the birds that eat the fish. When the accumulation of the toxic substances reaches a high enough level, it may kill the organism directly or interfere with its reproduction. A well-known example of such accumulation occurred in 1957 at Clear Lake, Calif. DDD (similar to DDT) was diffused through the water in a concentration of only 0.02 parts per million. The lake's plant and animal organisms, however, had stored residues of DDD at 5 parts per million—250 times greater than the concentration in the water itself. Fish, which consumed large quantities of these small organisms, accumulated DDD concentrations in their body tissues of over 2,000 parts per million. And there was heavy mortality among grebes which fed on the fish.

Radioactive fallout from the air also concentrates through food chains. Arctic lichens do not take in food through their roots but instead absorb their mineral nutrition from dust in the air. Radioactive fallout tends therefore to collect in the lichens and is further concentrated by grazing caribou, which eat huge quantities of lichen. Caribou meat is a major part of the Eskimo's diet. Although reconcentration of radioactive fallout at low levels has not been proved damaging to health, the effects of long-term, low-level exposure to radioactive pollutants are still not well known.

Water pollution is a problem throughout the country, but is most acute in densely settled or industrial sections. Organic wastes from municipalities and industries enter rivers, where they are attacked and broken down by organisms in the water. But in the process, oxygen in the river is used up. Nutrients from cities, industries, and farms nourish algae, which also use up oxygen when they die and decompose. And when oxygen is taken from the water, the river "dies." The oxygen is gone, the game fish disappear, plant growth rots, and the stench of decay reaches for miles.

Air pollution is now a problem in all parts of the United States and in all industrialized nations. It has been well known for some time to Los Angeles residents and visitors who have long felt the effect of highly visible and irritating smog from automobile exhaust. Now Los Angeles's local problem is becoming a regional problem, because noxious air pollution generated in the Los Angeles Basin has spread beyond the metropolitan area. This same problem, which seemed unique to Los Angeles in the 1950's is today common to major cities in the United States and abroad. Smog is but one of the many types of air pollution that plague the United States, especially its cities.

Land Use

Urban land misuse is one of today's most severe environmental problems. The character of our urban areas changes rapidly. Old buildings and neighborhoods are razed and replaced by structures designed with little or no eye for their fitness to the community's needs. A jumble of suburban developments sprawls over the landscape. Furthermore, lives and property are endangered when real estate developments are built on flood plains or carved out along unstable slopes.

Unlimited access to wilderness areas may transform such areas into simply another extension of our urban, industrialized civilization. The unending summer flow of automobiles into Yosemite National Park has changed one of nature's great wilderness areas into a crowded gathering place of lessened value to its visitors. The worldwide boom in tourism, teamed with rapid and cheap transportation, threatens the very values upon which tourist attraction is based.

The proposed jetport west of Miami and north of the Everglades National Park raised a dramatic land use problem. The jetport, together with associated transportation corridors, imperiled a unique ecological preserve. Planners for the jetport had considered density of population, regional transportation needs, and a host of other related variables. But they gave slight consideration to the wildlife and recreational resources of the Everglades. The jetport could have spawned a booming residential, commercial, and industrial complex which would have diminished water quality and without question drastically altered the natural water cycle of Southern Florida. This in turn would have endangered all aquatic species and wildlife within the park and beyond.

Natural Resources

Natural resource depletion is a particular environmental concern to a highly technological society which depends upon resources for energy, building materials, and recreation. And the methods of exploiting resources often create problems that are greater than the value of the resources themselves.

A classic case was the Federal Government's decision to permit oil drilling in California's Santa Barbara Channel. There, primary value was placed on development of the oil resources. The commercial, recreational, esthetic, and ecological values, which also are important to the residents of Santa Barbara and to the Nation, were largely ignored. The President recently proposed to the Congress that the Federal Government cancel the 20 Federal leases seaward from the State sanctuary extending 16 miles along the Santa Barbara Channel. This is where the blowout erupted in January 1969, spreading a coat of oil across hundreds of square miles including the sanctuary. This action illustrates a commitment to use offshore lands in a balanced and responsible way.

CAUSES OF PROBLEMS

Environmental problems seldom stem from simple causes. Rather they usually rise out of the interplay of many contributing circumstances.

Misplaced Economic Incentives

Many individuals cite selfish profit seekers for environmental degradation, rather than laying much of the blame—where it belongs—to misplaced incentives in the economic system. Progress in environmental problems is impossible without a clearer understanding of how the economic system works in the environment and what alternatives are available to take away the many roadblocks to environmental quality.

Our price system fails to take into account the environmental damage that the polluter inflicts on others. Economists call these damages—which are very real—"external social costs." They reflect the ability of one entity, e.g., a company, to use water or air as a free resource for waste disposal, while others pay the cost in contaminated air or water. If there were a way to make the price structure shoulder these external costs—taxing the firm for the amount of discharge, for instance—then the price for the goods and services produced would reflect these costs. Failing this, goods whose production spawns pollution are greatly underpriced because the purchaser does not pay for pollution abatement that would prevent environmental damage. Not only does this failure encourage pollution but it warps the price structure. A price structure that took environmental degradation into account would cause a shift in prices, hence a shift in consumer preferences and, to some extent, would discourage buying pollution-producing products.

Another type of misplaced incentive lies imbedded in the tax structure. The property tax, for example, encourages architectural design that leans more to rapid amortization than to quality. It may also encourage poor land use because of the need for communities to favor industrial development and discourage property uses, such as high-density housing, which cost more in public services than they produce in property taxes. Other taxes encourage land speculation and the leapfrog development that has become the trademark of the urban-rural fringe.

Values

American have placed a high priority on convenience and consumer goods. In recent times they have learned to value the convenience and comfort of modern housing, transportation, communication, and recreation above clean earth, sky, and water. A majority, like a prodigal son, have been willing to consume vast amounts of resources and energy, failing to understand how their way of life may choke off open space, forests, clean air, and clear water. It is only recently that the public has become conscious of some of the conflicts between convenience and a deteriorating environment.

In the early days of westward expansion, a period in which many national values were shaped, choices did not seem necessary. The forests, minerals, rivers, lakes, fish, and wildlife of the continent seemed inexhaustible. Today choices based on values must be made at every turn. Values can be gauged to some degree by the costs that the Nation is collectively willing to incur to protect them. Some of the costs of environmental improvements can be paid with local, State, and Federal tax money. But paying taxes and falling back on government programs is not enough. People may ultimately have to forgo some conveniences and pay higher prices for some goods and services.

Population

Americans are just beginning to measure the magnitude of the impact of population and its distribution on their environment. The concept that population pressures are a threat to the Nation's well-being and to its environment is difficult to grasp in a country which, during its formative decades, had an ever receding western frontier. That frontier ended at the Pacific many years ago. And it is at the western end of the frontier that some of the most serious problems of population growth emerge most clearly.

California continues to lure large numbers of Americans from all over the country, in large part because of its climate and its beauty. But as the people come, the pressures of population mount. Smog, sprawl, erosion, loss of beaches, the scarring of beautiful areas, and the congestion of endless miles of freeways have caused thoughtful Californians to consider stemming the continued uncontrolled development of their State. When the Governor's Conference on California's Changing Environment met last fall, it agreed that there was now a need "to deemphasize growth as a social goal and, rather, to encourage development within an ideal and quality environment."

The magnitude of the press of population, although significant, must be put in perspective. This is a vast country, and its potential for assimilating population is impressive, although there is disagreement over what level of population would be optimum. Some authorities believe that the optimum level has already been passed, others that it has not yet been reached. More troublesome, population control strikes at deeply held religious values and at the preference of some Americans for large families.

Population density outside metropolitan areas is not high. There is a desire—indeed an almost inevitable compulsion—to concentrate population in urban areas—primarily in the coastal and Great Lakes regions. If the trend continues, 70 to 80 percent of all Americans will be concentrated in five large urban complexes by the year 2000. The pressures that cause environmental problems that the Nation now confronts—water and air pollution and inefficient land use—will only increase.

Population growth threatens the Nation's store of natural resources. Currently the United States, with about 6 percent of the world's population, uses more than 40 percent of the world's scarce or nonreplaceable resources and a like ratio of its energy output. Assuming a fixed or nearly fixed resource base, continued population growth embodies profound implications for the United States and for the world.

Technology

The major environmental problems of today began with the Industrial Revolution. Belching smoke from factory stacks and the dumping of raw industrial wastes into rivers became the readily identified, but generally ignored hallmarks of "progress" and production. They are no longer ignored, but the extraordinary growth of the American economy continues to outpace the efforts to deal with its unwanted byproducts.

The growth of the economy has been marked not just by greater production but also by an accelerating pace of technological innovation. This innovation, although it has provided new solutions to environmental problems, has also created a vast range of new problems. New chemicals, new uses for metals, new means of transportation, novel consumer goods, new medical techniques, and new industrial processes all represent potential hazards to man and his surroundings. The pace of technological innovation has exceeded our scientific and regulatory ability to control its injurious side effects. The environmental problems of the future will increasingly spring from the wonders of 20th-century technology. In the future, technology assessment must be used to understand the direct and secondary impacts of technological innovation.

Mobility

The extraordinary, growing mobility of the American people constitutes another profound threat to the environment—in at least three major ways. The physical movement of people crowds in on metropolitan centers and into recreation areas, parks, and wild areas. Mobility permits people to live long distances from their places of employment, stimulating ever greater urban and suburban sprawl. The machines of this mobility—particularly automobiles and aircraft—themselves generate noise, air pollution, highways, and airports—all in their way affecting the environment.

The automobile freed Americans from the central city and launched the flight to the suburbs. As a consequence, thousands of acres of undeveloped land fall prey each year to the bulldozer. More single-family, detached homes shoulder out the open spaces. Many of these developments are drab in design and wasteful of land. They denude the metropolitan area of trees and thus affect climate; they cause erosion, muddy rivers, and increase the cost of public services.

Limitations of Government Units

Most government agencies charged with solving environmental problems were not originally designed to deal with the severe tasks they now face. And their focus is often too narrow to cope with the broad environmental problems that cut across many jurisdictions. Agencies dealing with water pollution, for example, typically do not have jurisdiction over the geographic problem area—the watersheds. Control is split instead among sewerage districts, municipalities, and a multitude of other local institutions. To attack water pollution effectively may require establishing new river basin authorities or statewide basin agencies with the power to construct, operate, and assess for treatment facilities.

Public decisions, like private decisions, suffer from the inadequate balancing of short-run economic choices against long-term environmental protection. There is a nearly irresistible pressure on local governments to develop land in order to increase jobs and extend the tax base—even if the land is valuable open space or an irreplaceable marsh. The problem is amplified by the proliferation of agencies, all competing narrowly, without consideration of broader and often common goals. The development that generates economic benefits in a town upstream may create pollution and loss of recreation in a town downstream.

Information Gap

Sometimes people persist in actions which cause environmental damage because they do not know that they are causing it. Construction of dams, extensive paving of land surfaces, and filling of estuaries for industrial development have in many cases been carried out with incomplete or wrong information about the extent of the impact on the environment. Furthermore, change in the environment has often been slow and exceedingly difficult to detect, even though piecemeal changes may eventually cause irreversible harm. Widespread use of certain types of pesticides, mercury pollution, and the use of dangerous substances such as asbestos occurred without advance recognition of their potential for harm.

EFFECTS OF PROBLEMS

Health

The impact of environmental deterioration on health is subtle, often becoming apparent only after the lapse of many years. The speed of change in a rapidly altering technological society and the complex causes of many environmental health problems produce major uncertainty about what environmental changes do to human well-being. Nevertheless, it is clear that today's environment has a large and adverse impact on the physical and emotional health of an increasing number of Americans.

Air pollution has been studied closely over the past 10 years, and its tie to emphysema and chronic bronchitis is becoming more evident.

These two diseases are major causes of chronic disability, lost workdays, and mortality in industrial nations. Estimates of deaths attributable to bronchitis and emphysema are beset with doubts about cause; nevertheless, physicians have traced 18,000 more deaths in the United States to these two causes in 1966 than 10 years earlier—an increase of two and one-half times. The increase of sulfur oxides, photochemical oxidants, and carbon monoxide in the air is related to hospital admission rates and length of stay for respiratory and circulatory cases.

Whether the accumulation of radioactive fallout in body tissues will eventually produce casualties cannot be predicted now, but close surveillance is needed. Nor has a direct correlation between factors in the urban environment and major malignancies of the digestive, respiratory, and urinary tracts been established. But the frequency of these diseases is much higher in cities than in nonurban environments.

Esthetics

The impact of the destruction of the environment on man's perceptions and aspirations cannot be measured. Yet today citizens are seeking better environments, not only to escape pollution and deterioration but to find their place in the larger community of life. It is clear that few prefer crowding, noise, fumes, and foul water to esthetically pleasing surroundings. Objections today to offensive sights, odors, and sounds are more widespread than ever. And these mounting objections are an important indicator of what Americans are unwilling to let happen to the world about them.

Economic Costs

The economic costs of pollution are massive—billions of dollars annually. Paint deteriorates faster, cleaning bills are higher, and air filtering systems become necessary. Direct costs to city dwellers can be measured in additional household maintenance, cleaning, and medical bills. Air pollution causes the housewife to do her laundry more often. The farmer's crop yield is reduced or destroyed. Water pollution prevents swimming, boating, fishing, and other recreational and commercial activities highly valued in today's world.

Natural Systems

Vast natural systems may be severely damaged by the improvident intervention of man. The great Dust Bowl of the 1930's was born in the overuse of land resources. Many estuarine areas have been altered and their ecology permanently changed. On a global scale, air pollution could trigger large-scale climatic changes. Man may also be changing the forces in the atmosphere through deforestation, urban construction, and the spilling of oil on ocean waters.

SOLVING PROBLEMS

In the short run, much can be done to reverse the deadly downward spiral in environmental quality. Citizens, industries, and all levels of government have already begun to act in ways which will improve environmental quality. The President's February 10 Message on the Environment spelled out some specific steps which can be taken now.

It is clear, however, that long-range environmental improvement must take into account the complex interactions of environmental processes. In the future, the effects of man's actions on complete ecosystems must be considered if environmental problems are to be solved.

Efforts to solve the problems in the past have merely tried—not very successfully—to hold the line against pollution and exploitation. Each environmental problem was treated in an ad hoc fashion, while the strong, lasting interactions between various parts of the problem were neglected. Even today most environmental problems are dealt with temporarily, incompletely, and often only after they have become critical.

The isolated response is symptomatic of the environmental crisis. Americans in the past have not adequately used existing institutions to organize knowledge about the environment and to translate it into policy and action. The environment cuts across established institutions and disciplines. Men are beginning to recognize this and to contemplate new institutions. And that is a hopeful sign.

II

Federal Organization for Environmental Quality

THE FEDERAL GOVERNMENT's pace in tackling environmental deterioration has greatly accelerated. The problems of pollution, waste, and degradation, haphazardly handled, have pressed in on daily living and forced Washington to become more deeply involved and better organized. This year President Nixon has proposed legislation on a wide range of environmental concerns. The Government has to reorganize for a comprehensive attack.

How the Federal Government is organized can strongly influence its strategies, programs, and effectiveness in coping with the environment.

In recent years, Federal institutions responsible for environmental quality have been handicapped by a managerial organization poorly suited to the task. The Federal Government has needed improvement in three environmental areas.

First, it has needed to sharpen both the development of environmental policy and the analysis of environmental trends and programs. Many problems of the environment cut across several Federal agencies, but no one agency—and until recently no special staff in the Executive Office of the President—has had an overview function.

Second, environmental concerns are often slighted when agencies pursue their primary missions with inadequate attention to side effects. For example, the agencies which construct or fund the construction of highways, dams, and airports are chiefly concerned with costs and engineering feasibility. Such quantitative factors usually overshadow adequate consideration of a project's environmental impact.

Finally, as environmental control programs grow in scope and authority, effective management grows more difficult. Different agencies carrying out like functions, such as standard setting, research, monitoring, and regulation, have operated independently of one another.

FEDERAL POLICYMAKING

Establishment of the Council on Environmental Quality

In May 1969, President Nixon established the first organizational entity charged with taking a broad overview of environmental problems—the Cabinet-level Environmental Quality Council, chaired by the President. It was still felt, however, that the Executive Office needed an independent organization concerned exclusively with environmental problems and yet not made up of the many existing agencies. Such an organization would be free to look at environmental problems in new ways and to propose new approaches for dealing with them. With broad bipartisan backing, the Congress enacted two related measures: the National Environmental Policy Act of 1969 and the Environmental Quality Improvement Act of 1970. The Cabinet-level Environmental Quality Council was abolished by Reorganization Plan No. 2 of 1970, which established a Domestic Council in the Executive Office of the President.

On January 1, 1970, President Nixon signed the National Environmental Policy Act (Public Law 91-190). That act established a national policy on the environment, placed new responsibilities on Federal agencies to take environmental factors into account in their decisionmaking, and created a Council on Environmental Quality in the Executive Office of the President. The President appointed Russell E. Train as chairman of the newly created Council and Robert Cahn and Gordon J. F. MacDonald members. They were confirmed by the Senate on February 6.

The act charges the Council with assisting the President in preparing an annual environmental quality report and making recommendations to him on national policies for improving environmental quality. It empowers the Council to analyze conditions and trends in the quality of the environment and to conduct investigations relating to the environment. It gives the Council responsibility for appraising the effect of Federal programs and activities on environmental quality, and authorizes funds for 1970–1973.

The Council's ability to perform its functions was significantly strengthened this year by the Environmental Quality Improvement Act of 1970 (Public Law 91–224) (see app. F), which was passed as title II of the Water Quality Improvement Act of 1970. This act created a new Office of Environmental Quality, which provides staff support to the Council. The Chairman of the Council on Environmental Quality serves as its Director and the activities of the Council and Office are meshed into one entity. The Act authorized funds for the Office, bringing the total authorization for the Council and the Office to $800,000 for fiscal year 1970; $1,450,000 for 1971; $2,250,000 for 1972; and $2,500,000 for 1973. The Environmental Quality Improvement Act also added to the responsibilities of the Council and the Office. It specified that they should review monitoring, evaluate the effects of technology, and assist Federal agencies in the development of environmental standards.

On March 5, 1970, the President issued Executive Order 11514. Together with the two public laws, it empowers the Council to recommend to the President and to Federal agencies priorities in environmental programs. Under the order and the acts, the Council will also promote the development and use of indices and monitoring systems and advise and assist the President and the agencies in achieving international environmental cooperation—under the foreign policy guidance of the Department of State. Taken together, the legislation and the Executive order provide a broad charter for the Council. They also provide a mandate for reform in the way Federal agencies make environmental decisions—from initial planning to implementation.

A New Step in Decisionmaking

The National Environmental Policy Act requires Federal agencies to take several significant steps. One is to include in every recommendation or report on legislation and on other major Federal actions significantly affecting the quality of the environment a detailed statement concerning the environmental impact of the action, adverse impacts that cannot be avoided, alternatives to the proposed action, the relationship between short- and long-term uses, and any irreversible commitment of resources involved. The detailed statements will include the comments of State and local environmental agencies as well as appropriate Federal agencies with environmental expertise. The statements will then be made available to the Council on Environmental Quality, the President, and the public.

Executive Order 11514 further requires that Federal agencies continually monitor their own activities to enhance environmental quality. The order also requires that the agencies provide for timely public information and hearings, where appropriate, on Federal plans and programs with potential environmental impact.

On April 30, the Council on Environmental Quality issued Interim Guidelines for the preparation of environmental statements, requiring each Federal agency to establish internal procedures for implementing this provision of the act by June 1, 1970. The Council's Interim Guidelines, published in the Federal Register (see app. G), will be reviewed and revised as necessary.

In addition to its immediate impact within the Federal establishment, the provision of the law requiring detailed environmental statements has been the subject of litigation in several lawsuits and administrative proceedings. In one instance a Federal court blocked a Federal loan to develop a wildlife habitat into a golf course pending submission of the required environmental analysis. In another, the Corps of Engineers was enjoined from removing the ground cover along a river in Arizona.

The environmental statements required of the agencies add a vital step to the decisionmaking process. Federal agencies are now required to consider explicitly the environmental implications of their actions. Such consideration will permit Federal, State, and local agencies and other Federal agencies having an interest in the environment to review the environmental implications of a Federal project before the project is undertaken. The Federal Government need no longer be in the position of trying to repair damage to the environment after the damage has been done because the relevant factors were not considered at the time of decision.

Council Activities

Since it was organized the Council has been involved in a wide variety of projects, many at the direction of the President. In his

February 10, 1970, Message on the Environment, the President directed the Council to provide leadership in the areas of agricultural pollution, in the development of nonpolluting power sources for the automobile, and in the recycling and reuse of solid wastes. In the area of solid wastes, the Council has been evaluating the feasibility of recycling junked automobiles, beverage containers, paper, and waste oil. In his April 15 Message to Congress on Waste Disposal, the President directed the Council, in consultation with other Federal agencies and State and local governments, to develop a Federal policy and programs for controlling disposal of wastes in the ocean.

The Council is involved in a number of other activities. It participated with other agencies in developing the President's proposals to control and prevent oil spills from ships and boats. It is now working with a number of Federal agencies on proposals to control air and water pollution, solid wastes, pesticides, noise, and mercury pollution; to reduce the phosphate content of detergents; and to control pollution in the Great Lakes.

The President, in Executive Order 11507, directed Federal agencies to undertake an extensive program to bring Federal facilities in line with air and water quality standards. That order envisions a 3-year program to demonstrate Federal leadership in the Nation's antipollution drive. The Council was made responsible for maintaining a continuing review of this program.

The Council has established three advisory committees. One, formed on April 6, 1970, advises the Council on the impact of current Federal, State, and local tax structures on the environment. A Legal Advisory Committee announced on April 30, advises the Council on a broad range of environmental legal questions. A task force on the development of a virtually nonpolluting automobile had its first meeting on July 9.

The Council is at work identifying improved indicators of environmental quality and determining requirements for comprehensive environmental monitoring systems. Current monitoring systems are often spotty in coverage and do not provide the total information necessary to assess environmental conditions and trends, or to predict the impact of proposed actions, or to determine the effectiveness of programs for protecting and enhancing environmental quality.

A number of additional broad environmental policy issues are also under consideration by the Council. It is evaluating a wide range of Federal programs for their impact on the development and growth of specific areas. It is measuring the sufficiency of land use planning and control at State and local levels, and it is seeking alternative institutional and control mechanisms for better land use management. It is also analyzing the growing levels of toxic substances injected into the environment by new and complex manufacturing processes and is searching for alternative ways to pretest and control them.

In all of these activities, the Council works closely with Executive Office agencies such as the Office of Science and Technology, Council of Economic Advisers, and Office of Management and Budget. It also works with the program agencies such as the Departments of the Interior; Health, Education, and Welfare; Agriculture; Transportation; Commerce, and others. Only by working through these agencies is it possible to deal with the broad range of environmental problems.

REORGANIZING THE FEDERAL STRUCTURE

The current fragmentation of programs for environmental protection makes it difficult for the Federal Government to pursue a coordinated anti-pollution strategy. Although many of the same pollutants may be disposed of either in the air or on water or land, major pollution control programs treat them separately according to the medium where they occur. Imbalance, overlap, and neglect come from confusion about the extent to which air and water pollution control agencies are responsible for radioactive materials and pesticides when these substances appear in air or water. Some agencies which administer environmental control programs also have developmental responsibilities which tend to be inconsistent with their environmental programs.

These problems have become increasingly apparent in recent years. In 1969, President Nixon directed his Advisory Council on Executive Organization, headed by Roy L. Ash, to make a thorough study of Federal environmental programs. The President stated in his 1970 Message on the Environment that he would recommend needed organizational reforms based on the Ash Council report.

On July 9, 1970, the President transmitted to the Congress two reorganization plans to improve administration of environmental and oceanographic programs. One plan would consolidate pollution control programs in a new, independent Environmental Protection Agency. The other would consolidate a number of marine and atmospheric programs in a new National Oceanic and Atmospheric Administration in the Department of Commerce. In his message on the two reorganization plans, the President said that "only by reorganizing our Federal efforts can we . . . effectively ensure the protection, development and enhancement of the total environment."

The Environmental Protection Agency

The Environmental Protection Agency (EPA) would combine programs now housed in five separate Federal agencies. It would be independent of any Cabinet agency—similar to NASA or the AEC. Its main role would be to establish and enforce standards, monitor and analyze the environment, conduct research and demonstrations, and assist State and local government pollution control programs.

The Federal Water Quality Administration, now in the Department of the Interior, and the National Air Pollution Control Administration, now in the Department of Health, Education, and Welfare (HEW), would be transferred to EPA. These would give EPA broad authority and ability to control air and water pollution. The new agency would carry out all the functions and responsibilities contained in the Clean Air and Federal Water Pollution Control Acts.

EPA would also take over the solid waste management program from HEW. It would take from the Federal Radiation Council the power to establish guidelines and recommend standards for radiation exposure. It would assume the authority of the Atomic Energy Commission to set standards for radiation hazards in the general environment.

The new Agency would pull together the widely scattered programs dealing with the environmental impact of pesticides. It would assume authority, now in the Department of Agriculture, to register pesticides. It would acquire the pesticide research and standard-setting programs of the Food and Drug Administration of HEW.

EPA's total budget would approach $1.4 billion, and it would employ almost 6,000 Federal personnel. It would be able to deal with significant problems that the current, fragmented organization of environmental protection programs is not capable of handling.

Many pollutants are not limited to one medium—air, land, or water—and are difficult to combat by media, which is the primary organizational basis of current programs. Pesticides, for example, which are applied to crops or land, degrade and disperse. Anywhere along the way, they may intrude on land, water, or air. EPA will be able to establish standards for the control of pollutants, taking into account the "total body burden"—that is, how much of a given substance an individual is exposed to whether it comes from air, water, or land. By bringing together research and monitoring activities from several agencies, EPA will be able to provide an "early warning system" against the accumulation of hazards.

Some pollution problems remain unrecognized because of gaps in agency jurisdiction or because no one agency has clear lead responsibility. With its broad responsibility for environmental protection, EPA would greatly improve the ability to recognize and to take action against such "new" pollution problems as noise. Pollution problems of the future will cut more and more across the jurisdictions of existing agencies, making the need for a unified agency even greater.

Also, the same source may contribute to several different kinds of pollution. Many industrial firms are able to choose the particular medium in which they will dump their wastes. The current organization deals separately with each medium. A case in New Jersey illustrates this problem. A manufacturing firm was required by court order to control air pollution pouring from the stacks of one of its large factories. The firm installed control devices which converted the gaseous wastes into a liquid. But then the wastes were dumped into a nearby river, and the firm is now back in court for violating water quality standards. Creation of EPA cannot guarantee that such problems will no longer arise. But it can provide more rational standards and more coordinated enforcement, which will permit industry and State and local governments to work toward total environmental improvement.

Current environmental protection programs compete for funds with health, resource, and development programs—with no clear framework for establishing priorities among them. EPA will provide an opportunity to weigh priorities carefully and develop an optimum mix of manpower and funds. It will be able to marshall improved overall strategies for attacking pollution problems.

The new EPA and the Council on Environmental Quality will reinforce each other's mission. The Council is essentially a staff organization. It is not intended to have operating responsibilities. Its function is to advise the President on environmental policies, to coordinate all activities of the Federal agencies related to environmental quality and to work with the agencies to insure that environmental consideration be a key element of decisionmaking. EPA, on the other hand, will be responsible for executing antipollution policies and for carrying out the many functions involved in controlling pollution. It will assist the

Council in developing and recommending to the President new policies for the protection of the environment.

There is also a difference in the scope of concern of the two agencies. The Council is responsible for the environment, broadly defined. This includes such subjects as population, land use, and conservation. The new agency will focus specifically on pollution control, which is only one part of the Council's responsibilities. But, creation of EPA will be a key building block in achieving the comprehensive view of environmental matters which the Council seeks.

The National Oceanic and Atmospheric Administration

The National Oceanic and Atmospheric Administration (NOAA) would be composed of selected marine programs transferred from the Department of the Interior, the National Science Foundation (NSF), the Coast Guard, the Navy, and the Army Corps of Engineers. Its budget would total about $270 million, and it would have a personnel strength of over 12,000. These programs would be transferred to NOAA: Environmental Science Services Administration (Commerce); most elements of the Bureau of Commercial Fisheries, the marine sport fish program from the Bureau of Sport Fisheries and Wildlife, the major part of the anadromous fish program, and the marine mining program (Interior); the Office of Sea Grant Programs (NSF); the national data buoy development program (Coast Guard); and the Great Lakes Survey (Corps of Engineers). NOAA would be located in the Department of Commerce.

The NOAA proposal in large part reflects the recommendations of the Commission on Marine Science, Engineering and Resources as published in its report, "Our Nation and the Sea," in January 1969. The President, in transmitting the proposal to Congress, stated that he expected NOAA to "exercise leadership in developing a national oceanic and atmospheric program of research and development."

A Coordinated Attack

In his message to the Congress of July 9, the President called his reorganization proposals "an opportunity to re-evaluate the adequacy of existing program authorities. . . . As these two new organizations come into being, we may well find that supplementary legislation to perfect their authorities will be necessary. I look forward to working with the Congress in this task."

NOAA provides new opportunities to improve understanding of oceanic and atmospheric resources. The creation of the Council on Environmental Quality and the reorganization plan for an Environmental Protection Agency represent a bold move in Federal organization for environmental quality. For the first time, the Nation will have the type of policy and organizational focus to mount an effective, coordinated attack on pollutants and other forms of environmental decay.

III

Water Pollution

Throughout history man has been ravaged by plague and epidemics visited on him by poor sanitation and polluted water. In more modern times, the great typhoid epidemics that swept London in the mid-19th century underscored the peril of water pollution and launched the first organized steps to combat it. And until very recent times this stress on preventing waterborne disease was the major thrust of efforts to stem the decline of the environment.

Americans have acted, until recently, as though their rivers and lakes had an infinite capacity to absorb wastes. Pollution was considered the price of progress. Not until 1948 was comprehensive Federal water pollution control legislation enacted, and the first permanent legislation was not passed until 1956. The original overriding concern was with human health, and almost all State water pollution programs were carried on by State health departments.

Water pollution control legislation and programs have now been broadened to embrace a host of environmental concerns, including recreation and esthetics. Epidemics due to waterborne causes are largely of the past, and our health efforts have moved to a more sophisticated concern for the effects of small amounts of toxic chemicals on humans and other forms of life.

Three reasons, besides the changed nature of the health problem, help explain the broader environmental concern of today: First, the growth of industries and cities has multiplied pollution in most waterways; second, demand for outdoor recreation has grown in a society increasingly affluent and leisure oriented; and third—a thread running through all the others—is man's inexplicable affinity to water. Whether it is the pleasure he derives from a fountain, the mood of a walk along the lake shore, the relaxation of fishing, or his identification with majestic water bodies—the Danube, the Great Lakes, or San Francisco Bay—man has found tranquility and inspiration in his appreciation of water. But, the current condition of many of our lakes and rivers makes appreciation impossible.

Pollution problems exist in all parts of the United States, particularly in the Northeast and in the Great Lakes region. In these areas, which have experienced tremendous urban and industrial growth over the past century, there was, at least until recently, inadequate investment in the construction of treatment plants. Now a big backlog of needed construction has accumulated. Specific sources of pollution, besides the ordinary municipal and industrial wastes, affect certain areas. Acid mine pollution is common in the coal mining States of Appalachia, and saline pollution occurs in the irrigation areas of Western States.

In some areas of the country, remedial programs have succeeded in raising the levels of water quality. However, population and industrial growth, higher water quality demanded by the public, and the increasing severity of certain types of pollution—for example, oil spills and increased algal blooms in lakes—all mean that we have only begun to tackle the problem.

NATURAL PROCESSES AND WATER POLLUTION

Several basic biological, chemical, and physical processes affect the quality of water.

Organic wastes decompose by bacterial action. Bacteria attack wastes dumped into rivers and lakes, using up oxygen in the process. Organic wastes are measured in units of biochemical oxygen demand (BOD), or chemical oxygen demand (COD), both measures of the amount of oxygen needed to decompose them. The COD measure is more inclusive than BOD, but BOD is much more commonly used. Fish and other aquatic life need oxygen. If the waste loads are so great that large amounts of oxygen are spent in their decomposition, certain types of fish can no longer live in that body of water. A pollution-resistant, lower order of fish, such as carp, replace the original fish population. The amount of oxygen in a water body is therefore one of the best measures of its ecological health.

If all the oxygen is used, an anaerobic (without air) decomposition process is set in motion with a different mixture of bacteria. Rather than releasing carbon dioxide in the decomposition process, anaerobic decomposition releases methane or hydrogen sulfide. In these highly polluted situations, the river turns dark, and odors—often overwhelming—penetrate the environment.

Heated water discharged into lakes and rivers often harms aquatic life. Heat accelerates biological and chemical processes, which reduce the ability of a body of water to retain dissolved oxygen and other dissolved gases. Increases in temperature often disrupt the reproduction cycles of fish. By hastening biological processes, heat accelerates the growth of aquatic plants—often algae. Finally, the temperature level determines the types of fish and other aquatic life that can live in any particular body of water. Taken together, these effects of excess heat operate to change the ecology of an area—sometimes drastically and rapidly.

One of the most serious water pollution problems is eutrophication—the "dying of lakes." All lakes go through a natural cycle of eutrophication, but normally it takes thousands of years. In the first stage—the oligotrophic—lakes are deep and have little biological life. Lake Superior is a good example. Over time, nutrients and sediments are added; the lake becomes more biologically productive and shallower. This stage—the mesotrophic—has been reached by Lake Ontario. As nutrients continue to be added, large algal blooms grow, fish populations change, and the lake begins to take on undesirable characteristics. Lake Erie is now in this eutrophic stage. Over time, the lake becomes a swamp and finally a land area.

Man greatly accelerates this process of eutrophication when he adds nutrients to the water—detergents, fertilizers, and human wastes. He has done this in Lake Erie and countless other lakes. Man's action can, in decades, cause changes that would have taken nature thousands of years.

WHERE WATER POLLUTION COMES FROM

Although water pollution comes from many sources, the major ones are industrial, municipal, and agricultural.

Industrial Wastes

The more than 300,000 water-using factories in the United States discharge three to four times as much oxygen-demanding wastes as all the sewered population of the United States. Moreover, many of the wastes discharged by industry are toxic. Table 1 shows the amount of water consumed by various industries and the pollution loads, before treatment, that they produce. The output of industrial wastes is growing several times faster than the volume of sanitary sewage.

TABLE 1.—*Estimated Volume of Industrial Wastes Before Treatment, 1964*[1]

Industry	Waste-water volume (billion gallons)	Process water intake (billion gallons)	BOD (million pounds)	Suspended solids (million pounds)
Food and kindred products	690	260	4,300	6,600
Meat products	99	52	640	640
Dairy products	58	13	400	230
Canned and frozen food	87	51	1,200	600
Sugar refining	220	110	1,400	5,000
All other	220	43	670	110
Textile mill products	140	110	890	N.E.
Paper and allied products	1,900	1,300	5,900	3,000
Chemical and allied products	3,700	560	9,700	1,900
Petroleum and coal	1,300	88	500	460
Rubber and plastics	160	19	40	50
Primary metals	4,300	1,000	480	4,700
Blast furnaces and steel mills	3,600	870	160	4,300
All other	740	130	320	430
Machinery	150	23	60	50
Electrical machinery	91	28	70	20
Transportation equipment	240	58	120	N.E.
All other manufacturing	450	190	390	930
All manufacturing	13,100	3,700	22,000	18,000
For comparison: Sewered population of United States	[2] 5,300	----------	[3] 7,300	[4] 8,800

[1] Columns may not add, due to rounding.

[2] 120,000,000 persons times 120 gallons times 365 days.

[3] 120,000,000 persons times 1/6 pound times 365 days.

[4] 120,000,000 persons times 0.2 pound times 365 days.

Source: Data derived from T. J. Powers, National Industrial Waste Assessment, 1967.

Although there is as yet no detailed inventory of industrial wastes, indications are that over half the volume discharged to water comes from four major industry groups—paper, organic chemicals, petroleum, and steel.

The greatest volume of industrial wastes is discharged in the Northeast, the Ohio River Basin, the Great Lakes States, and the Gulf Coast States. Lesser, but significant volumes are discharged in some areas of the Southeast and the Pacific Coast States.

Most industrial water waste can be curbed—and much has been—by treatment and by designing production processes that minimize waste. For example, the average waste from modern sulfate pulp and paper plants is only 7 percent of what it was in the older sulfite process. Treatment processes are now available for most industrial wastes. Their total estimated costs, as a percentage of gross sales by all industry are well under 1 percent, although costs are much higher for some industries. Also, many industrial wastes—those from food processing, for example—can be treated efficiently (after pretreatment in some cases) in municipal waste treatment systems.

Some industrial pollution, however, presents difficult abatement problems. The trend toward using and shipping complex chemical products has greatly increased the possibility of releasing wastes in the environment. Many of these new chemicals are very difficult to detect and to control, and there is fear that too little caution and study preceded the processing and marketing of some of these materials.

Small amounts of heavy metals can be a problem. For example, until early this spring, little attention was given to mercury, although separate incidents of mercury poisoning had occurred in Japan and Sweden. Currently, levels of mercury above Food and Drug Administration standards have been discovered in more than 20 States with the result that in many of them, sport and commercial fishing has been curtailed. The Federal Government has collected data on the sources of mercury discharge—mainly chemical plants—and has sought court action against eight firms. The Council on Environmental Quality is coordinating long-term Federal agency efforts to spell out the danger and develop remedial programs.

Many authorities believe that waste heat looms as one of the most serious types of future water pollution. The chief source of thermal pollution today is the electric power industry, which requires tremendous amounts of water for cooling. Other sources include petroleum, chemical, steel, and pulp and paper processing. The heaviest users are listed in table 2.

The best single indicator of future potential for thermal pollution is the predicted increase in the generation of electricity. The electric power industry is growing at a rate of 7.2 percent annually, virtually doubling every 10 years. This trend is expected to continue, as table 3 shows.

TABLE 2.—*Use of Cooling Water by U.S. Industry*

Industry	Cooling water intake (billions of gallons)	Percent of total
Electric power	40, 680	81. 3
Primary metals	3, 387	6. 8
Chemical and allied products	3, 120	6. 2
Petroleum and coal products	1, 212	2. 4
Paper and allied products	607	1. 2
Food and kindred products	392	0. 8
Machinery	64	. 3
Rubber and plastics	128	. 3
Transportation equipment	102	. 2
All others	273	. 5
Total	50, 065	100. 0

Source: Federal Water Pollution Control Administration, "Industrial Waste Guide on Thermal Pollution," September 1968.

TABLE 3.—*U.S. Electric Power—Past Use, Future Estimates*

Year:	*In billion kilowatt-hours*
1912	12
1960	753
1965	1, 060
1970	1, 503
1975	2, 022
1980	2, 754
1985	3, 639

Source: Federal Water Pollution Control Administration, "Industrial Waste Guide on Thermal Pollution," September 1968.

The principal use of water in steam-electric generating plants is for condenser cooling. The amount of water necessary depends on plant efficiency and the designed temperature rise within the condensers. The temperature rise of cooling water condensers is usually in the range of 10° to 20° F., with the average rise about 13° F. Large nuclear steam electric plants require about 50 percent more condenser water for a given temperature rise than late model fossil-fueled, steam-electric plants of equal size. However, the development of advanced reactors, such as the fast breeder, will essentially eliminate the difference between nuclear and fossil-fueled plants. It is estimated that by 1980, cooling operations by the electric power industry will require the equivalent of one-fifth of the total fresh water runoff of the United States.

Municipal Wastes

Municipal waste treatment plants handle more than just domestic wastes from homes and apartments. On a nationwide average, about 55 percent of the wastes processed by municipal treatment plants comes from homes and commercial establishments and about 45 percent from industries. Less than one-third of the Nation's population is served by a system of sewers and an adequate treatment plant. About one-third is not served by a sewer system at all. About 5 percent is served by sewers which discharge their wastes without any treatment. And the remaining 32 percent have sewers but inadequate treatment plants. Of the total sewered population, about 60 percent have adequate treatment systems. The greatest municipal waste problems exist in the areas with the heaviest concentrations of population, particularly the Northeast.

Three levels of treatment are employed in municipal treatment plants. Primary treatment is a simple gravity process that separates and settles solids in a big tank. Such primary plants provide BOD removal levels of 25 to 30 percent. Secondary treatment is a biological process that speeds up what nature does in natural water bodies. In the activated sludge process used by many large cities, bacteria and air are mixed with sewage to accelerate decomposition of wastes. The other secondary treatment process—the trickling filter—involves spraying wastes uniformly over a rock bed. Bacteria formed on the rocks, in the presence of air, accelerates decomposition of wastes. Good secondary treatment plants remove 90 percent of measured BOD. That does not mean that 90 percent of total oxygen-demanding wastes are removed, but only the part that is measured by certain laboratory tests.

Advanced waste treatment, often called tertiary treatment, involves a wide variety of processes tailored for specific treatment needs. For example, one advanced waste treatment process is lime-alum precipitation, which removes 80 percent of phosphates from waste water, compared to an average of 30 percent in normal secondary treatment. Other processes, using carbon adsorption and sand filtering, remove up to 99 percent of measured BOD.

The waste loads from municipal systems are expected to nearly quadruple over the next 50 years. Even if municipal and industrial waste loads are cut substantially through treatment, pollution problems will continue to plague densely populated and highly industrialized areas where the capacity to assimilate waste is exceeded.

Among other municipal waste problems that will grow more apparent as conventional treatment reduces gross pollution loads are those caused by storm or combined sewers and by nutrients. Many cities have combined sewers, which discharge raw sewage along with street runoff directly to streams when treatment systems become overloaded during storms or thaws. Even where sewers are separated, pollution from storm sewer discharges carrying a variety of wastes from the streets is possible. Although combined sewer problems exist in most regions of the country, the most severe are centered in the Northeast, Midwest, and to some degree, the Far West.

Municipal wastes contribute the major load of usable phosphates and significant amounts of nitrates to water bodies. Already nutrient pollution has led to a strict requirement for very high treatment levels for waste discharges to the Great Lakes and several other areas. Secondary treatment plants remove an average of 30 percent of the phosphorous and up to 20 percent of the nitrogenous materials, although with modifications higher levels of treatment are possible. In many places treatment levels approaching 100 percent will probably be necessary—especially if the phosphate content of detergents is not reduced.

Agricultural Wastes

Wastes from feedlots are a key source of agricultural pollution. The increasing number of animals and modern methods of raising them contributes to the worsening pollution of waters by animal wastes. Beef cattle, poultry, and swine feeding operations, along with dairy farms, are the major sources of actual or potential water pollution from animal wastes. In the United States today, the number of animals, their waste equivalents to humans, and the total waste equivalent are as follows:

	Animal population (in millions) (1)	Ratio of waste output of single animal to output of a human (2)	Total animal wastes expressed as equivalent number of humans (in millions of humans) (3)
Cattle	107	16.40	1,754.8
Horses	3	11.30	33.9
Hogs	53	1.90	100.7
Sheep	26	2.45	63.7
Chickens	375	0.14	52.5
Total [1]	564		2,005.6

[1] Col. 1 times col. 2 equals total in col. 3.

Source: Data derived from Federal Water Pollution Control Administration, "Cost of Clean Water," vol. 2, 1968.

Hence, animal wastes are estimated to be the equivalent of the wastes of 2 billion people. These figures should not be interpreted as an estimate of the potential pollution from feedlots, however, since most of these wastes never reach the water. But they are a measure of the total amount of animal wastes, part of which causes water pollution and solid waste problems.

Agricultural waste sources are scattered throughout the Nation. Large cattle herds are fed in the Midwest, West, and Southeast; poultry in the South and in the Middle Atlantic States; and hogs in the Midwest and South. If current consumption rates continue, animal wastes will increase significantly. The trend toward confined feeding and concentrated rations is bound to add to the pollution potential of feedlot wastes although better control methods are being developed.

Fertilizers contain nitrogen and phosphorus, two primary nutrients that nourish algae in water. Nitrates are the bigger problem since, unlike phosphates, which stick to soil, nitrates are very susceptible to runoff from rain. Also, nitrates leach into ground water. High nitrate concentrations in water cause infant methemoglobinemia or "blue baby." The use of chemical fertilizers has increased rapidly in the United States over the last decade and is expected to continue to rise, although at somewhat slower rates. In some areas, particularly in the West, water leached from irrigated lands has caused serious water pollution. In the Western United States, salt content in many rivers exceeds the levels considered acceptable for most types of crops. The problems resulting from use of pesticides, which pollute the air, the land, and the water, are covered in chapter VII.

Other Sources

Sediment and erosion—Sediments carried by erosion represent the greatest volume of wastes entering surface waters. The volume of suspended solids reaching U.S. waters is at least 700 times greater than the total sewage discharge loadings. Sediments are washed in from croplands, unprotected forest soils, overgrazed pastures, strip mines, roads, or bulldozed urban areas. Agricultural development increases land erosion rates four to nine times over what they are for natural cover. Construction may increase the rate a hundredfold. A 1969 report of the Federal Water Quality Administration estimated the average sediment yield during a rainstorm at highway construction sites at about 10 times that for cultivated land, 200 times that for grass areas, and 2,000 times that for forest areas—depending on the rainfall, land slope, and the exposure of the bank. Similar rates of sediment production occur from commercial and industrial construction in urban areas.

Oil and other hazardous substances—With the grounding of the *Torrey Canyon* in 1967, the breakup of the *Ocean Eagle* in Puerto Rican waters in 1968, and the Santa Barbara offshore oil leak in 1969, oil pollution has become recognized as a serious national and worldwide problem. An estimated 10,000 spills of oil and other hazardous materials annually pollute navigable waters of the United States. Although damages from other hazardous substances can be just as significant and diverse as those caused by oil pollution, the volume of oil transported and used makes it the most important single pollutant of this type.

Most oil spills exceeding 100 barrels come from vessels, although about one-third of the incidents involve pipelines, oil terminals, and bulk storage facilities. Vessel casualties are a prime source of oil pollution. Damage from several million gallons of oil entering the water at one time and place can be extensive.

TABLE 4.—*Number of Reported Oil Spills in U.S. Waters (Over 100 Barrels)*

	1968	1969
Vessels	347	532
Shore facilities	295	331
Unidentified	72	144
Total	714	1,007

Source: Federal Water Quality Administration, "Clean Water for the 1970's," June 1970.

Oil pollution may spring from several other sources. Gasoline service stations dispose of 350 million gallons of used oil per year, much of which was previously re-refined. Two hundred thousand miles of pipelines, carrying more than a billion tons of oil and hazardous substances, cross waterways and reservoirs and are subject to leakage. The blowout of offshore oil and gas wells, the dumping of drilling muds and oil-soaked wastes, the destruction of offshore drilling rigs by storms, and ship collisions—all are significant potential sources of pollution.

With more and more oil and hazardous materials being transported, the number of spills could grow. On the other hand, tightened regulations developed for oil exploration and production and sounder ship and pipeline construction could reduce this number.

Mine drainage—Mine drainage is one of the most significant sources of water pollution in Appalachia, in the Ohio Basin States, and in certain other areas of the country.

In Appalachia alone, where an estimated 75 percent of the coal mine pollution occurs, about 10,500 miles of stream are dropped below desirable quality levels by acid mine drainage. Similar drainage from other types of mining—such as phosphate, sand and gravel, clay, iron, gold, copper, and aluminum—pollutes other regions of the country. Acid formation occurs when water and air react with the sulfur-bearing minerals in the mines or in refuse piles to form sulfuric acid and iron compounds. Coal mines idle for 30 to 50 years may still discharge large quantities of acid waters. Mine drainage also contains copper, lead, zinc, and other metals toxic to aquatic life.

Watercraft wastes—About 46,000 federally registered commercial vessels, 65,000 unregistered commercial fishing vessels, 1,600 federally owned vesels, and 8 million recreational watercraft ply the navigable waters of the United States according to FWQA. The potential sewage pollution from these vessels is estimated to equal that from over 500,000 persons—comparable to the population of a city the size of San Diego. As a total source of pollution, it is insignificant, but it can be a major impediment to achieving clean water in some harbors and recreational areas. Further vessel pollution occurs when ships discharge bilge and ballast water heavy with oils and other substances.

WHAT WATER POLLUTION DOES

Water pollution stems from many sources and exists in many forms to assail man's senses and hamper his activities. It may appear as oil slicks, as public health notices against swimming, or as masses of aquatic weeds making drinking water undrinkable. More subtle are long-term changes in the aquatic life of a river—the decline of sport fish and the ascendance of carp, sludge worms, and other life forms tolerant of pollution.

. . . *to Health*

Epidemics of typhoid, dysentery, and salmonellosis borne by polluted water are no longer serious public health threats in the United States. To protect the public from these and other pollution dangers, however, water must often be treated to high levels before it is drinkable. Beaches often must be closed and shellfish left unharvested and unmarketed. Inadequately disinfected municipal wastes, overflows from combined sewer systems, and runoff from animal feedlots often create high bacteria densities in local water supplies.

A survey prepared by the Department of Health, Education, and Welfare points to disquieting quality deficiencies in some community water systems, particularly in small communities. Also, there is mounting public health concern over chemical constituents in water. The effects on humans of small amounts of toxic chemicals in water supplies are not known, but health authorities show increased concern over their potential effects. Accelerated research is needed for better understanding of these dangers. The technology to maintain safe bacteriological quality and to remove many of the potentially dangerous chemicals from drinking water exists but is not as widely employed as necessary.

. . . *to Recreation*

Reduction of recreational opportunities represents the most widespread consequence of water pollution. Three major types of recreational activities may be hampered by water pollution:

- ***Boating and water skiing***—Such water pollution as floating solids, gas bubbles and odors, and algal blooms make boating and water skiing unpleasant. And if bacterial levels are sufficiently high, water pollution can be a health hazard to water sportsmen.
- ***Swimming***—When bacterial counts reach certain levels, public health authorities close beaches. Inadequately disinfected wastes from municipalities and overflows from combined sewers are principal bacterial polluters in populated areas.
- ***Sport fishing***—The highest water quality is needed to maintain populations of certain types of game fish. When water quality declines, the fish die. For example, the most popular fresh water

sport fish, the trout, requires cold water and dissolved oxygen levels in excess of 5 parts per million to live and reproduce. On the other hand, carp, a "trash" fish, can live with dissolved oxygen levels below 4 parts per million, and even below 2 parts per million for a limited time.

Fish can die from all types of pollution, but the majority of fish kills are caused by lack of dissolved oxygen, pesticides, and by toxic wastes from industrial operations. In 1969, over 70 percent of the kills were caused by industrial waste and 20 percent by agricultural waste. Most of the fish killed were "trash" or "rough" fish—those already tolerant of water pollution.

. . . to Esthetics

The esthetic qualities of water also represent a use by man. That use may take the form of picnicking, hiking, or just driving near a body of water. Besides ruining the visual enjoyment, pollution can cause unpleasant odors, especially when algae clog the water or when anaerobic conditions exist. Also, sediment, which can turn waters murky brown, reduces their esthetic appeal.

. . . to Commercial Fishing

Commercial fishing is an important industry in some areas of the country. In 1969, domestic landings totaled about 4.9 billion pounds of fish and shellfish valued at $354 million. Although total landings fell to 4.3 billion pounds in 1969, the value to the fisherman had increased to $518 million. The extent to which water pollution, compared to other factors, contributed to the lower level of landings is unknown.

. . . to Agriculture

Saline pollution is the water quality problem which primarily affects agriculture. As water is used by plants and evaporates, the concentration of salt rises. As salt levels in water increase, the farmer may have to shift to lower yielding, salt-resistant crops.

. . . *to Industrial Water Supplies*

Studies indicate that industry generally treats water to its desired level to assure constant quality, rather than depending on water withdrawn directly from rivers and lakes. It would be cheaper for industrial concerns to treat nonpolluted or less polluted water, but the extra treatment costs for industry are usually not significant.

. . . *to Municipal Water Supplies*

Small amounts of potentially toxic materials, the effects of which are not well known, are not removed by many drinking water treatment plants. Water pollution also increases the costs of treating water at intake for domestic uses. However, studies indicate that the extra costs of treating polluted water to meet current standards are not significant. Several forms of water pollution, however, such as algae or small amounts of phenols, a byproduct of a number of manufacturing processes, adversely affect the taste and odor of water. For reasons of taste and custom, people are often reluctant to draw water from polluted sources. For example, the quality of water that Philadelphia takes from the Delaware River is about the same as that of the Hudson River near New York City, but New Yorkers have been most reluctant to use the Hudson River as a source of drinking water.

WHAT WATER POLLUTION CONTROL COSTS

The amount of money needed to clean up polluted water is great. The direct costs are immense, but a substantial part of the costs are indirect. For example, any lasting solution is bound to involve modification of construction, agricultural, and water management practices.

The cost over the next 5 years for municipal waste treatment plants to meet water quality standards is estimated at $10 billion—about $2 billion a year. Operating charges are estimated to rise from $410 million a year in 1969 to $710 million in 1974. The costs of dealing with problems of combined sewer overflows have been put by the American Public Works Association at between $15 and $48 billion—depending on the alternatives chosen.

TABLE 5.—*Annual Outlays for Water Pollution Control*

[In millions of current dollars]

Year	Industrial outlays		Municipal outlays			Total annual outlays
	Investment	Operating charges	Investment		Operating charges	
			Treatment works	Collection		
1965	640	200	476	355	270	1,940
1966	780	270	520	400	295	2,215
1967	565	365	550	505	320	2,306
1968	530	430	655	500	350	2,465
1969	740	515	880	450	410	2,995
1970[1]	655	555	2,000	([2])	[3] 470	>3,680
1971	655	595	2,000	([2])	530	>3,780
1972	655	635	2,000	([2])	590	>3,880
1973	655	675	2,000	([2])	650	>3,980
1974	655	715	2,000	([2])	710	>4,080

[1] 1970–74 expenditures represent those associated with an investment level that will achieve controls required by water quality standards within the period.

[2] No estimates available.

[3] No estimate of incremental collection operating and maintenance costs.

Source: Federal Water Quality Administration.

Industrial abatement costs, excluding those for waste heat from power production, are estimated at $3.3 billion over the next 5 years. Annual industrial operating costs will increase from $515 million in 1969 to $715 million in 1974. Up to another $2 billion would be necessary in the next 5 years to provide recirculation of water to prevent thermal pollution.

Costs for controlling other pollution sources are grounded on widely varying assumptions as to what is necessary, desirable, or possible. As analysis improves, these costs can be calculated as part of the total costs necessary to meet water quality objectives.

GOVERNMENT ACTION

Federal Efforts

The first temporary water pollution control legislation was passed in 1948. Permanent legislation was enacted in 1956. The Federal Water Pollution Control Act of 1956 authorized planning, technical assistance, grants for State programs, and construction grants for municipal waste treatment facilities. Amendments followed in 1961, which among other things, extended Federal enforcement authority and increased construction grant authorizations.

In 1965, more amendments established the Federal Water Pollution Control Administration as successor to a program previously in the Public Health Service of the Department of Health, Education, and Welfare. The Administration was transferred to the Department of the Interior in May 1966. The most important provisions in the 1965 act called for the establishment of water quality standards and implementation plans for clean-up of all interstate and coastal waters.

The Clean Water Restoration Act of 1966 provided more Federal money for building treatment facilities. The Water Quality Improvement Act of 1970 gives a new name to the responsible agency, the Federal Water Quality Administration; provides tighter controls over oil pollution, vessel pollution, and pollution from Federal activities; and broadens the earlier laws in other respects.

Setting water quality standards—The water quality standards authorized by the 1965 legislation set the stage for the current strategy for water quality management. The act called on the States to establish standards for their interstate waters, which can then be approved as Federal standards by the Secretary of the Interior. To set these standards, the States had to make crucial decisions about desired uses of their water resources, the quality of water that they need to support uses, and specific plans for achieving quality levels. Most water quality standards carry antidegradation clauses seeking to insure that high-quality waters are maintained at existing levels of purity.

The States are the primary enforcers of water quality standards. If they fail to act, the Secretary of the Interior may then set standards and enforce them. The standards of all the States have now been approved. The goal—to provide nationwide, comprehensive water quality standards—however, is far from reached. Over half the States established standards that were not stringent enough in all aspects to assure adequate water quality protection. So the Secretary excepted parts of them from initial approval. For example, the temperature criteria of a number of States have been excepted because they did not set adequate safeguards against thermal pollution. In some cases implementation plans have not been approved because the abatement measures or the schedules were inadequate. The Secretary of the Interior is negotiating with the States concerned, and a number of them have agreed to raise their standards. In one case, where no agreement was reached, the Secretary has taken initial action to impose Federal standards.

Even when standards have been approved, there is a need to improve knowledge of water quality characteristics so that the standards can be upgraded. For example, general criteria on toxic materials are written into all of the approved water quality standards. But in many of the standards, specific limits on such products as pesticides have not been spelled out. Nor have definitive measures for implementing standards been detailed. The standards generally require secondary treatment—or its equivalent—for industrial wastes, even though this is a crude measure for industrial wastes, and may not be adequate to forestall pollution in particular areas. In his February 10 Message on the Environment, the President said that he was requesting authority to require the States, with Federal approval, to set specific effluent discharge requirements as part of water quality standards. These would arm the States and the Federal Government with a tool to assure that water quality goals would be met. It would provide a standard against which the States and the Federal Government can enforce compliance.

Enforcing standards—Vigorous State and Federal enforcement is critical if the Nation hopes to attain water quality standards. Several States are moving aggressively against polluters. Illinois has not hesitated to open proceedings against major industrial firms. Pennsylvania successfully carried through on the first test of its clean stream law. And with the passage of its Water Quality Act in 1969, California has vastly buttressed and stepped up its regulatory activity.

Last year, the Federal Government launched its first action to curb violations of water quality standards under the Water Quality Act of 1965. On August 30, 1969, the Secretary of the Interior ordered six alleged violators to clean up their pollution within 180 days or face court action. Each took remedial steps and court action was forestalled. On May 19, 1970, the Secretary took action against five other alleged violators under this procedure.

Joint Federal-State enforcement conferences have been stepped up. The Biscayne Bay conference in February 1970 was the 50th conference enforcement action taken since 1956. Five of these actions—Lake Superior, Escambia River Basin, Perdido Bay, Mobile Bay, and Biscayne Bay—have been started since January 1, 1969. Eight other conferences were reconvened, and three progress meetings were held to review progress in compliance. The Refuse Act of 1899 provides fines and criminal sanctions for dumping wastes into navigable waters without a permit. This authority, assigned to the Army Corps of

Engineers, has been invoked in several recent actions, notably in the Lake Michigan area. The Federal Government is initiating new efforts to control pollution through the exercise of the Refuse Act's permit functions. Section 21(b) of the new Water Quality Improvement Act of 1970 requires applicants for Federal permits to file with permit requests certification from the appropriate State or interstate pollution control agency that its activity will not violate water quality standards. The Federal Government will invoke new procedures for requiring permits to discharge materials into navigable waters.

Assisting communities to treat wastes.—The Federal Government gives grants to municipalities to build waste treatment works. The legislation permits the Government to make basic grants of 30 percent of the costs of construction. In States in which the State government provides financial help and has enforceable water quality standards plus a comprehensive plan, the Federal share can go up to 55 percent.

Since 1957, the Federal Government has paid out $1.5 billion to help build and expand over 10,000 municipally owned and operated sewage treatment plants. With this money States and cities have constructed $6.4 billion in treatment works. In 13 years of such grants, the population served by some degree of waste treatment has jumped by more than 51 million people

Despite this progress, many cities still lag in modern waste treatment. Many facilities were designed to provide levels of treatment which have since proved inadequate. Other plants have become outgrown and overloaded. Others, crippled by improper operation and maintenance, have been beset by polluted discharges and have lapsed into early obsolescence.

Sheer population growth has speeded the overloading of many treatment plants. During the years in which the Federal Government has financed sewage treatment, that part of the population using sewers and thus discharging wastes that must be treated has grown by 35.7 million persons. Higher standards of living and the universal use of household chemicals and appliances which add to the waste load—garbage grinders, for instance—have also overloaded sewage treatment plants. And in many river basins, success in treating wastes from municipalities has often been offset by failure to deal simultaneously with other waste sources.

Despite Federal assistance in the past, waste treatment plant construction needs have far outpaced all available financing. Not until 1970 did Federal funding take any major leap upward—from $214 million in 1969 to $800 million. To meet treatment needs after 1970, the

President has requested $4 billion—$1 billion a year for 4 years—to be matched by $6 billion in State and local funds, for a total $10 billion program. That level of funding was arrived at from a study of requirements by the Federal Water Quality Administration and an independent canvass of the States' estimated needs. The Administration's legislation would require a reassessment in 1973 to estimate future need.

The Administration also seeks authority to set up an Environmental Financing Authority (EFA) to help remove barriers for local communities that want to participate in the grant program. EFA would buy the obligations of State and local governments to help finance treatment plant construction when they cannot get credit elsewhere on reasonable terms. EFA would obtain funds to make these purchases by issuing its own taxable obligations in large enough blocks to win favorable reaction in the market. The differential between the interest that EFA must pay on its obligations and the rates that State and local governments pay back to EFA would be made up by regular Federal payments. By providing an assured commitment on grant funds and credit assistance, the Administration's proposals would overcome the obstacles that have prevented needed investment growth in the past.

Controlling oil—The Santa Barbara blowout and subsequent incidents show conclusively that no fully effective techniques are available to control oil spills in the ocean or large lakes. And common straw, which soaks up oil so that it can be removed, is still the standard material for cleaning up after oil spills. The Water Quality Improvement Act of 1970 tightens the law and strengthens the Federal hand to prevent and control oil pollution. It requires notification of spills and establishes financial liability for cleanup costs. It also authorizes a $35 million revolving fund for emergency oil cleanup by the Federal Government. Regulations issued by Secretary Hickel on August 22, 1969, tighten Federal control and make industry liable for spills occurring from oil and gas exploration and production on the Outer Continental Shelf.

On May 20, the President announced a comprehensive list of proposals to deal with oil pollution. He advocated Senate ratification of three international treaties, asked Congress for legislation to give the Federal Government authority to regulate handling and transfer of oil cargoes, and recommended more research in detecting and removing oil spills. Ten days later, the Chairman of the Council on Environmental Quality released a new National Contingency Plan which details responsibilities for oil spill cleanup.

Vessel wastes—In recent years, many States have enacted new laws and regulations or have strengthened old ones for controlling vessel wastes. Unfortunately, nonuniformity of State requirements poses significant compliance problems for vessels that travel between States. Also, in many cases the State regulations do not cover, or inadequately cover, interstate and international carriers.

The Water Quality Improvement Act of 1970 embodied comprehensive Federal legislation covering the control of vessel wastes. It provides for the establishment of effluent standards for sanitary waste discharges from all classes of watercraft—new and old. It penalizes vessel owners and manufacturers for failing to provide adequate shipboard treatment or sanitary waste control.

Controlling Federal activities—The Federal Government itself carries on many activities that affect water quality. It maintains Federal facilities—such as military bases, lighthouses, and post offices. It manages Federal lands. It dredges, develops nuclear energy, and controls pests. Today, in the United States, the Federal Government owns approximately 20,000 pieces of property and one-third of the country's land area.

On February 4, 1970, the President issued Executive Order 11507, which launched an aggressive approach to clean up water and air pollution from Federal facilities. The order demands that all projects or installations owned or leased by the Federal Government be designed, operated, and maintained to meet air and water quality standards. Under it, pollution control projects must be finished or underway by December 31, 1972. To ensure that funds, once appropriated, are channeled to the intended purpose, the order stops them from being used for anything but pollution control.

Control of water pollution from other Federal activities is covered by a number of laws and administrative arrangements. The Water Quality Improvement Act requires that States certify projects before Federal agencies can give them licenses or permits. The Fish and Wildlife Coordination Act requires that the Department of the Interior comment before the Corps of Engineers issues a dredging permit. The National Environmental Policy Act requires agencies carrying out projects to issue a detailed statement on what the project will do to the environment.

Research and development—Much is already known about the technology of water pollution control. But there are still major gaps in knowledge. New technology is being developed and tested, largely through a program of grants, contracts, and demonstrations with municipalities and industries. Municipal and industrial treatment technology, oil spill control, and agricultural pollution claim highest priority. The 1971 Federal budget sets aside $61 million for research, development, and demonstration by all agencies.

Monitoring and surveillance—Adequate enforcement of water quality standards demands accurate factfinding and ready data. The Federal Water Quality Administration (FWQA), the U.S. Geological Survey, and State pollution control agencies have been jointly developing a nationwide water quality surveillance system for several years. Part of the network is already in operation. Some 400 FWQA-funded and operated stations, 260 FWQA-funded and U.S. Geological Survey-operated stations, 200 stations jointly funded by the State and Federal agencies, and 500 State-funded and operated stations make up the surveillance web. It now covers about 20 percent of the Nation's streams. Ultimately it will grow into a complex of thousands of State and Federal stations. Network data will be supplemented by many short-term intensive FWQA field studies of specific water quality problems.

A number of other Federal agencies run monitoring and surveillance programs. The Environmental Science Services Administration of the Department of Commerce, the Coast Guard, the Corps of Engineers, the Bureau of Commercial Fisheries, and others have programs. They do not generate data for enforcement, but they do add to the Nation's knowledge of the pollutant load in the water, how it is dispersed, and how it reacts.

Helping States—State agencies have major responsibility in the national water pollution control effort. But often they are underequipped for the task. Federal grants spur State and interstate agencies to expand and improve their programs. The grant program started in 1957 with $2 million and has grown to $10 million today. State and interstate agency expenditures to match Federal funds have increased sixfold in that time. The President has asked for legislation to triple the Federal share over 5 years—from $10 million to $30 million—and to provide bonus funds for control, inspection, and manpower programs.

State Efforts

The years since 1965 have seen significant strides in State water pollution control programs. The amount and significance of legislation introduced and enacted in State legislatures in recent sessions and the rise in appropriations for support of State water pollution control programs point to progress. A rapidly rising number of States now financially assist the construction and operation of local waste treatment plants. Thirty-one States have authorized assistance programs, and all but 10 of these States have funded their programs. Some States provide other forms of assistance. For example, Nebraska, New Hampshire, and New York underwrite local bond issues; and at least 23 States award to industry tax incentives in one form or another.

States have tightened supervision over local waste disposal operations. They have expanded monitoring and inspection of treatment plants and have upgraded operators' qualifications and skills by mandatory certification requirements and training programs. Forty-six States require permits for municipal and industrial discharges; six States inspect treatment plants monthly, five quarterly, and 13 annually; 43 States require monthly operating reports; 16 States require mandatory certification of waste treatment plant operators. Unfortunately, in many States, these mechanisms do not work as well as they could.

State legislatures themselves are looking hard at the organizational structure for administering State water pollution control programs. At least 16 States have acted in this area. Most of those States have taken part or all of the water quality responsibility from health departments and created either water quality boards, made up of representatives of a number of State agencies, or combined water quality responsibilities with natural resources activities. Some States—for example, New Jersey and New York—have combined their air and water pollution activities in an even more comprehensive approach to environmental management. Perhaps the most exciting organizational innovation has been the statewide treatment authority. Ohio has authorized an Ohio Water Development Authority, with power to construct, operate, and assess charges for treatment plants in that State. Maryland has recently created a Waste Acceptance Service with similar functions. Overall, State spending for pollution control programs in fiscal year 1970 will more than triple spending in 1965, increasing from about $11.2 million to an estimated $36 million.

WHERE WE STAND

Problems and Their Control

As discussed earlier, the two major sources of organic pollution are industrial and municipal wastes, with industrial discharges contributing three to four times the waste loads of municipal systems. Reduction of pollution from industrial sources—where abatement technology is generally available—is largely a matter of attaining necessary investment levels.

According to extremely tentative figures, industrial investments for water pollution control facilities increased in 1969 over 1968. The actual spending for industrial pollution control facilities in 1968, however, was less than the amounts previously projected.

Although the level of industrial investment appears to be close to the level necessary to meet water quality standards, there is room for concern that the industries putting money in now are the most public spirited firms, and in the years ahead the main burden of investment will have to be carried by the less highly motivated firms. If this is true, the investment level is likely to fall unless Federal and State enforcement is greatly strengthened.

The cost of solving pollution from municipal discharges will be high over the next 5 years. According to FWQA estimates, about $10 billion of capital investment will be needed to meet water quality standards, compared to about $3.3 billion for industry. (Industry's capital costs are much lower than are municipalities' because the wastes do not have to be collected from a wide area and because firms generally choose less capital intensive abatement measures.) Since 1965, the level of investment in municipal facilities has nearly doubled—from $476 million to $880 million—but it must reach an annual level of $2 billion to cut backlogs and keep pace with future population and expansion. The President's program will help achieve this level.

Current monitoring systems are not adequate to determine the extent of improvement or deterioration of water quality. In some isolated cases, such as Lake Washington in Seattle and San Diego Bay, improvement has been dramatic. In other areas water quality has deteriorated. Given the Administration's proposed level of funding, more uniform improvement is likely in the next few years.

Nutrient Enrichment

Eutrophication is emerging as perhaps the single most difficult water pollution control problem. It is especially vexing because even as gross organic waste loads are reduced by injections of money into treatment plants, eutrophication does not stop. It will continue to prevent achievement of high quality water. The causes of eutrophication have recently been under debate. Some claim that carbon stimulates algal growth and is the chief cause, rather than phosphates, which had long been the suspected controlling factor. To learn more about this, the Council on Environmental Quality and the Office of Science and Technology (OST) met with a number of outside scientific experts and Federal agency personnel. The staff of the Council, the OST, and the Department of the Interior concluded that phosphates are still the most important nutrient to control if eutrophication is to be successfully attacked. They held that carbon is only likely to be limiting where algal blooms are already at unacceptable levels.

The largest amount of useable phosphates reaches water from municipal sources. Phosphates in detergents account for approximately 50 percent of the total. A second source, less amenable to control, is runoff of phosphate fertilizers from land. Nitrogen, another contributor to eutrophication, especially in the western part of the United States, also originates from municipal discharges and land runoff.

Toxicity Levels

Increasingly complex manufacturing processes, coupled with rising industrialization, create greater amounts of exotic wastes potentially toxic to humans and aquatic life. Current levels of cadmium, lead, and other substances whose effects on humans and fish and wildlife are not fully understood constitute a mounting concern. And mercury pollution has become a serious national problem.

Waste Heat

Waste heat is one of the most serious emerging sources of water pollution. The electric power industry, which currently discharges over 80 percent of all the thermal heat into the Nation's waters, doubles its capacity every decade. The trend toward larger, nuclear plants, which create 50 percent more thermal pollution in water per unit of power than fossil-fuel plants, could result in damage to aquatic systems—if it is not controlled. With the tremendous thermal pollution potential of projected power production, it is fortunate that waste heat from electric generating plants can be adequately controlled. Waste heat and thermal pollution can be reduced by improving the efficiency of the plants; by making productive use of heat; and by the use of cooling towers, cooling ponds, or spray ponds.

Enforcement—Enforcement has not reached its full potential for two reasons. First, the Federal Government's authority over standards—under the Federal Water Pollution Control Act—generally extends only to interstate waters. It does not adequately cover intrastate and ground waters. Second, the implementation plans of the States do not specifically spell out the maximum amounts of effluent that can be discharged within the standards. Enforcement provisions are also inadequate. Under the Federal Water Pollution Control Act, the Federal Government has jurisdiction only if the pollution from one State endangers the health and welfare of another State; or if the Governor of the State in which the pollution occurs requests it (except for shellfish damage or for oil and vessel pollution). The conference-hearing procedure is cumbersome and time-consuming. Finally, the only force that the Government can wield against a polluter is a cease-and-desist order, and the court's only option in the case of noncompliance is a contempt-of-court action. The act does not provide for fines to enforce compliance. The use of the Corps of Engineers' permit authority as a basis for enforcement will add some Federal muscle.

The President recommended in his February 10 Environmental Message a broad range of tough new enforcement provisions. These include: extending jurisdiction to intrastate pollution and groundwaters, streamlining the enforcement procedures, establishing specific effluent requirements, and setting fines up to $10,000 a day for noncompliance. The procedures under which enforcement has been carried out have been less than satisfactory. There has been no clear rationale for convening enforcement conferences; rather, they have tended to be reactions to critical local problems. Even when held, the results have been mixed. In many cases, abatement schedules agreed to by the Federal Government and the States have slipped seriously. The purpose of any enforcement program is voluntary compliance. What has been lacking is a systematic process that makes clear to municipalities and industries the timing and type of enforcement and penalties if they fail to comply on schedule. Nevertheless, enforcement conferences have spurred State and local governments and industry to make investments that they otherwise would not have made. The pace of recent actions indicates that the Federal Government intends to enforce existing water pollution laws vigorously. But significant changes in the system of enforcement will be necessary to meet current and future requirements.

State Programs

Although States are better able to cope with water pollution than with air pollution, they are still generally unable to meet the massive requirements to implement water quality standards. Lack of funds and personnel is the major reason. Low salary scales and poor merit systems discourage many talented persons from seeking jobs in State and local water pollution control agencies.

Local Programs

Construction and operation of waste treatment facilities have traditionally been left to individual municipalities. In too many cases, a collection of small, uncoordinated treatment plants ring a city, when a more efficient and effective solution would have been a regional treatment system. Local jealousies and, in the past, the Federal grant system have encouraged this fragmentation. The current proliferation of small plants independent of each other in a number of communities is poor economics and poor pollution control.

It is poor economics because small plants cannot operate as cheaply as big plants. (However, economies of scale are not infinite. An optimum system may include a mix of large and small plants to permit both economies of scale and optimum use of the assimilative capacity of the receiving waters.) It is poor pollution control because of the almost impossible task of getting a large number of communities and industries in a single metropolitan area to plan and construct plants on a coordinated basis. Not only is coordination difficult, but with many diverse authorities, some will fail to take adequate steps to halt pollution. Also, a large single plant can obtain the skilled personnel necessary for sound operation.

As in the State agencies, lack of manpower and funds are a problem. Surprisingly large numbers of treatment plants are operated poorly because of inexperienced personnel. This reduces the plants' contribution to pollution control and shortens their useful life. But the most pressing problem is raising funds for the construction of waste treatment facilities—even when the Federal Government bears a large part of the cost. Not only is it becoming difficult to find sources of revenue in the face of rising demands for public services, high costs, and high interest rates, but legal and constitutional restrictions can be barriers to issuing bonds.

Monitoring and Information

Water quality monitoring and information systems are not adequate. The systems tend to be spotty in geographic coverage and in the parameters that they cover. Data often are not quickly available. There is no method of combining data to develop indices to help policy makers and the public determine the types of control programs necessary. Finally, there is a shortage of data on the amounts and types of pollutants discharged.

WHAT NEEDS TO BE DONE

The Council on Environmental Quality recommends the following:

1. *Investment in waste treatment facilities must be significantly raised and kept at a sustained high level by enactment of the President's $4 billion program of Federal grants.*

Coupled with State and local matching funds, that program would embrace a $10 billion effort. The President's proposal for an Environmental Financing Authority should also be promptly enacted.

2. *Management reforms must be vigoroulу implemented to meet water quality goals effectively and efficiently.* In his February 10 message, the President listed the following reforms in the FWQA waste treatment grant program:

- Federally assisted treatment plants will be required to meet prescribed design, operation, and maintenance standards and be operated only by State-certified operators.
- Municipalities receiving Federal assistance in constructing plants will be required to impose charges on industrial users sufficient to meet the cost of treating industrial wastes.
- Comprehensive river basin plans will be required at an early date to insure that Federally assisted treatment plants will, in fact, contribute to effective cleanup of entire river basin systems.
- Wherever feasible, communities will be encouraged to cooperate in the construction of large regional treatment facilities

providing economies of scale and more efficient and more thorough waste treatment.

Better management of waste treatment programs is absolutely essential—to meet higher water quality standards and to insure that public funds are not wasted. Continued evaluation of the ongoing progress of implementation will be necessary to determine whether additional and more effective measures are necessary.

3. *The FWQA and other Federal waste treatment assistance programs should give priority to encouraging the development of regional treatment systems in metropolitan areas based on comprehensive sewer, water, and land use planning.*

4. *These Federal programs must also encourage localities to impose user charges on the amount and strength of wastes to increase equity and to work toward self-financing systems.* These charges would cover not only industrial wastes, for which policy already exists, but home and commercial wastes as well.

5. *Vigorous and effective enforcement of water quality standards must be implemented.* The President's proposals to extend Federal jurisdiction to intrastate and groundwaters, streamline the conference-hearing procedures, establish effluent requirements, and set fines up to $10,000 a day for violations should be enacted promptly. The basic process of enforcement should be improved. Information systems must be developed to include specific data on implementation schedules. Expansion of Federal and State sampling stations, coupled with an industrial waste inventory, are high priority. States, municipalities, and industries should systematically be warned of violation of standards. If action does not follow and if extenuating circumstances do not exist, the Federal Government should automatically seek court action.

6. *Increased attention must be given to encouraging changes in State and local institutions dealing with water pollution control.* The Council recommends that:

- Efforts be made to provide a demonstration in one river basin of the most advanced concepts of water quality management. Such a demonstration might use regional treatment facilities; nontreatment alternatives such as in-stream aeration and low flow augmentation; and new financial incentives, such as effluent charges. The proposal would demonstrate the techniques to meet water quality management needs in the future, when the problems from increasing population and industrialization grow even more acute. The FWQA should consider how existing assistance programs could be channeled to such a demonstration.

- Consideration be given to incentives for improving water quality institutions generally. To provide incentives, there must be more knowledge of the merits and faults of various institutional alternatives. One alternative that should be explored for more widespread application is Statewide sewage treatment authorities similar to those authorized by Maryland and Ohio. Other alternatives that should be explored include river basin commissions or authorities and regional government entities to provide sewerage facilities. Besides identifying the best types of institutions for managing water quality, careful attention should be given to the types of incentives, financial or otherwise, necessary to encourage new types of institutions.

7. *A concerted and comprehensive attack should be made on eutrophication.* Three actions are necessary: One, phase phosphates out of detergents as soon as feasible; two, find better methods to control agricultural runoff; and three, remove more of the nutrients from wastes generated by towns and cities, particularly in urban centers and in critical areas such as the Great Lakes.

8. *A program should be formulated to deal with urban runoff and pollution from combined sewer overflows.* Research on alternative methods of separation has uncovered some interesting approaches. In a plan for the District of Columbia, an overflow lake would be created to treat combined sewer overflows, and the treated water would then be channeled into two other lakes for recreation. Promising proposals should be put into operation as demonstrations of what can be done. Clearly the costs and disruption that complete separation entails make it an unattractive approach. In developing solutions to combined sewer overflows, it is necessary to deal with the broader problem of urban runoff which in itself can create high bacterial pollution. As experience mounts and the chances for choosing wrong alternatives diminish, the development of a broader remedial program should be evaluated.

9. *State programs need to be significantly improved.* A major step forward is the tripling of support to State and interstate agencies, as announced by the President. Emphasis must be placed on improving the capabilities of State pollution control agencies to monitor, enforce, and inspect the operations of sewage treatment facilities.

10. *Professional, technical, and operator manpower must be trained.* Manpower needs in water pollution control are great, and training

should be accelerated. The Federal Government, States, municipalities and industries must all share in the costs and responsibilities if a truly effective program is to be launched.

11. *A strong and consistent Federal policy should be developed to control thermal pollution.* Criteria should be upgraded to assure prompt and successful negotiations with the States on water quality limits from thermal pollution, as well as from other sources of water pollution.

12. *A policy and programs should be developed for ocean disposal of wastes.* In his April 15 message to the Congress on Waste Disposal, the President directed the Council on Environmental Quality, working with the Secretaries of the Interior and of the Army, other Federal agencies, and State and local agencies, to determine research needs, legislative changes, and other recommendations to deal with the problem of ocean disposal. The report, due September 1, will focus on new directions and policies in disposal of a wide variety of wastes in ocean waters.

13. *More research, development, and demonstration are needed in several areas.* New methods must be developed to prevent, control, and clean up oil spills. New methods should be developed to deal with waste heat, with more emphasis on its beneficial use. Broader research is required to define and anticipate adverse effects from water pollutants, including the subtle long-term effects from small amounts of toxic chemicals.

14. *Efforts to assure the safety of municipal water supplies should be increased.* This will mean greater research on the potential health hazards which may be contained in drinking water and more thorough surveillance of drinking water supplies. Current knowledge, surveillance, and control of such hazards are inadequate.

15. *More demonstrations on reuse and recycling of waste waters and sludge should be conducted.* Most abatement plans look toward treatment and disposal into water bodies. The materials left over, the so-called sludge, are disposed of as a solid waste. More creative solutions for reuse, such as using the fertile waste water for irrigation systems (providing both water and nutrients), recharging of ground water, and use of recreation lakes as the end of the treatment process are necessary. Tertiary treated waste waters could be used as a source of domestic and industrial water supply. The nutrient-rich sludge might be used productively as a soil conditioner.

16. *Water quality management should be considered in the broader context of overall waste management.* Water pollution, like other

forms of pollution, is a problem of materials balance. If the materials normally considered waste are used for productive purposes, pollution problems are diminished. Recycling of materials—paper, for example—would also reduce pollution from primary production. New chemicals, offshore oil loading facilities, and new methods of generating power will all have an impact on the environment—positive or negative. Attention must be given to "technology assessment" to prevent future pollution and to choose alternative courses that will reduce it. Strategies to deal with water pollution or any other pollution should take into account these broader waste management considerations.

17. *The attack on problems from agricultural pollution should be intensified.* Among these are nutrients from fertilizers; animal wastes, especially from feedlot operations; pesticides; and irrigation returnflows. New techniques must be developed and demonstrated for controlling agricultural pollution as soon as possible. At the same time, more action can and should be taken now to deal with these problems. The Council is currently working with Federal agencies and universities to evaluate the status of control techniques and the best research and action approaches.

18. *Mechanisms may be required to protect water against a wide variety of materials that enter the environment and that are not covered under current regulatory authorities.* The Council is exploring the feasibility of a program to pretest and control products and residuals that can be harmful to human health, to wildlife, and to plant life.

Looking Toward the Future

The Nation is on the threshold of a major attack on water pollution, but the goal is not easily won. The President's proposals for a $10 billion financing program and tighter enforcement will reverse the worst water pollution, but other water pollution problems will become even more apparent. In the short run, there is no easy solution to this highly complex problem. In the long run, control of water pollution will require institutional and management changes, possibly some changes in the products that people consume. It will require large amounts of public funds, and it will lead to higher prices for some products.

The financing and management tools to solve the water quality problems of the future are yet to be developed. The Nation's ability to develop these tools is its most important challenge in attaining high-quality water.

IV

Air Pollution

WE TEND to view air pollution as a recently discovered phenomenon. But since the dawn of the industrial revolution, people in many communities have endured levels of smoke pollution that would be held intolerable today. In the last half of the 19th century, a surprising number of aroused citizen groups protested the smoke-laden air of London. But their protests were lost in the overwhelming clamor for industrial development at any price.

Progress in the United States was no more heartening. Chicago and Cincinnati passed smoke control laws in 1881. By 1912, 23 of the 28 American cities with populations over 200,000 had passed similar laws. But still there was little dent made in air pollution.

In the 1930's, 1940's, and 1950's smoke pollution reached its zenith in the United States, especially in Eastern and Midwestern industrial cities. The public outcry against these conditions resulted in the enactment of improved smoke pollution legislation, its partial enforcement, and a visible improvement in the air of some industrial cities. These local control efforts focused primarily on cutting down smoke from fossil fuels, particularly coal. The fortunate advent of diesel engines in place of steam locomotives and the increased use of gas as a fuel for space heating also helped cut back air pollution in that era.

The Donora disaster in Pennsylvania in 1948 pricked the conscience of the Nation, but the experience of Los Angeles beginning in that same decade was a more certain sign of the complex air pollution problem which now confronts cities throughout the world. When the citizens of Los Angeles began to complain of smog, few people suspected that air pollution was a great deal more than just smoke. Los Angeles used virtually none of the fuels primarily responsible for the smoke problems of cities elsewhere; yet smog appeared and worsened. Dr. Arie J. Haagen-Smit, of the California Institute of Technology, finally pinpointed the principal sources of photochemical smog in Los Angeles—hydrocarbons and nitrogen oxides from automobile exhausts. Smog was at first thought to be a phenomenon amplified by local weather conditions and limited to Los Angeles. Today, however, most major cities are afflicted to some degree by photochemical smog as well as by other forms of air pollution.

Air pollution is for the most part a phenomenon of urban living that occurs when the capacity of the air to dilute the pollutants is overburdened. Population and industrial growth and a high degree of dependence on the motor vehicle cause new gaseous and particulate emissions to complement, interact with, and further complicate the traditional ones.

When the first Federal air pollution control legislation was passed in 1955, there were no viable ongoing State programs at all. There was little interest in the scientific community, and the public, by and large, equated air pollution with coal smoke and considered smog a problem unique to Los Angeles. It is no wonder that air pollution is regarded as a recently discovered phenomenon.

POLLUTANTS AND THEIR SOURCES

Five main classes of pollutants are pumped into the air over the United States, totaling more than 200 million tons per year. These are summarized in table 1 for 1968, the latest year for which data are available for making estimates.

Transportation—particularly the automobile—is the greatest source of air pollution. It accounts for 42 percent of all pollutants by weight. It produces major portions not only of carbon monoxide but of hydrocarbons and nitrogen oxides.

Table 1.—*Estimated Nationwide Emissions, 1968*

[In millions of tons per year]

Source	Carbon monoxide	Particulates	Sulfur oxides	Hydrocarbons	Nitrogen oxides	Total
Transportation	63.8	1.2	0.8	16.6	8.1	90.5
Fuel combustion in stationary sources	1.9	8.9	24.4	.7	10.0	45.9
Industrial processes	9.7	7.5	7.3	4.6	.2	29.3
Solid waste disposal	7.8	1.1	.1	1.6	.6	11.2
Miscellaneous [1]	16.9	9.6	.6	8.5	1.7	37.3
Total	100.1	28.3	33.2	32.0	20.6	214.2

[1] Primarily forest fires, agricultural burning, coal waste fires.

Source: NAPCA Inventory of Air Pollutant Emissions, 1970.

Carbon monoxide (CO) is a colorless, odorless, poisonous gas, slightly lighter than air, that is produced by the incomplete burning of the carbon in fuels. Carbon monoxide emissions can be prevented by supplying enough air to insure complete combustion. When this occurs, carbon dioxide, a natural constituent of the atmosphere, is produced instead of carbon monoxide.

Almost two-thirds of the carbon monoxide emitted comes from internal combustion engines, and the overwhelming bulk of that comes from gasoline-powered motor vehicles.

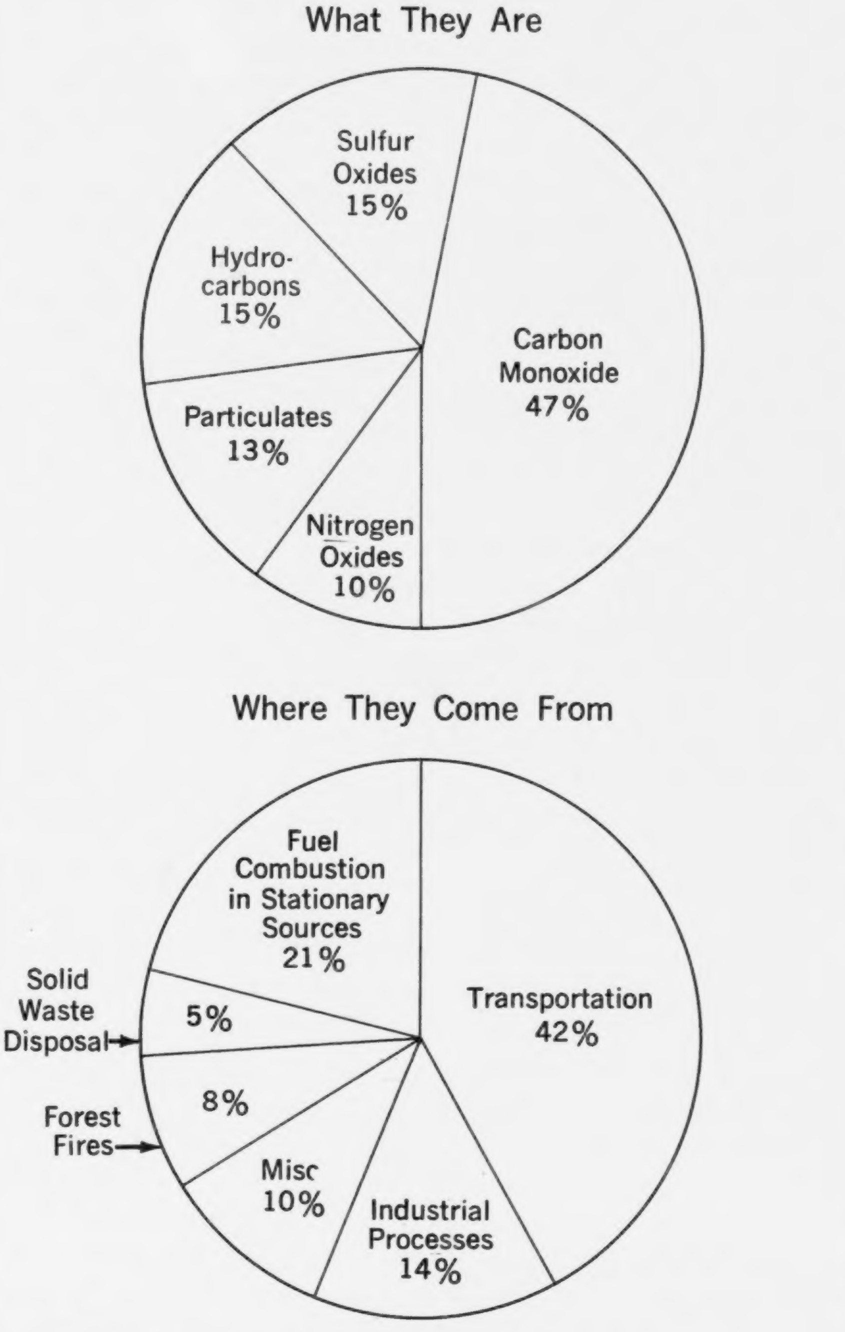
Particulate matter includes particles of solid or liquid substances in a very wide range of sizes, from those that are visible as soot and smoke to particles too small to detect except under an electron microscope. Particulates may be so small that they remain in the air for long periods and can be transported great distances by the winds. They are produced primarily by stationary fuel combustion (31 percent) and industrial processes (27 percent). Forest fires and other miscellaneous sources account for 34 percent.

There are established techniques for controlling particulates from a boiler stack or from a waste air stream—among them filtering, washing, centrifugal separation, and electrostatic precipitation. These work well for most of the particles, but complete removal, especially of the very finest particles, is technically and economically difficult.

Sulfur oxides (SO_x) are acrid, corrosive, poisonous gases produced when fuel containing sulfur is burned. Electric utilities and industrial plants are its principal producers since their most abundant fuels are coal and oil, which contain sulfur as an impurity. The burning of coal produces about 60 percent of all sulfur oxides emissions, oil about 14 percent, and industrial processes that use sulfur 22 percent.

Air Pollution Emissions in the United States, 1968

Percentage by weight



Source: National Air Pollution Control Administration, HEW.

Most of the coal and oil is burned in electric power generation plants. About two-thirds of the Nation's sulfur oxides are emitted in urban areas, where industry and population are concentrated. And seven industrial States in the Northeast account for almost half of the national total of sulfur oxides. In rural areas, however, sulfur oxides sources may be large industrial plants, smelters, or power plants. Any one of these may throw out several hundred thousand tons of sulfur oxides in a year.

Government agencies and industry have sought to reduce sulfur oxide emissions in three ways: switching to low sulfur fuels (those with less than 1 percent sulfur), removing sulfur from fuels entirely, and removing sulfur oxides from the combustion gases.

Hydrocarbons (HC), like carbon monoxide, represent unburned and wasted fuel. Unlike carbon monoxide, gaseous hydrocarbons at concentrations normally found in the atmosphere are not toxic, but they are a major pollutant because of their role in forming photochemical smog. More than half the estimated 32 million tons of hydrocarbons produced each year comes from transportation sources, mainly gasoline-fueled vehicles. Another 27 percent comes from miscellaneous burning and 14 percent from industrial processes. About 60 percent is produced in urban areas, largely because there are more automobiles.

Nitrogen oxides (NO_x) are produced when fuel is burned at very high temperatures. Stationary combustion plants produce 49 percent of the nitrogen oxide emissions; transportation vehicles, 39 percent; and all other sources, 12 percent.

Internal combustion engines operate at very high temperatures, and so do efficient, large electric power and industrial boilers. Nitrogen that is ordinarily inert combines with oxygen in high temperature flames and tends to stay combined if the exhaust gases are cooled too quickly. The control of NO_x from stationary sources requires careful adjustment of flame and stack gas temperatures. Control of nitrogen oxides from automobiles is more difficult because reducing other pollutants can increase the output of NO_x.

Under the influence of sunlight, nitrogen oxides combine with gaseous hydrocarbons to form a complex variety of secondary pollutants called *photochemical oxidants*. These oxidants, together with solid and liquid particles in the air, make up what is commonly known as smog. The photochemical oxidant family of pollutants includes, among others, ozone, an unstable, toxic form of oxygen; nitrogen dioxide; peroxyacyl nitrates; aldehydes; and acrolein. In air they can cause eye and lung irritation, damage to vegetation, offensive odor, and thick haze.

WHAT AIR POLLUTION DOES

Air pollution adversely affects man and his environment in many ways. It soils his home and interferes with the growth of plants and shrubs. It diminishes the value of his agricultural products. It obscures his view and adds unpleasant smells to his environment. Most important, it endangers his health.

The extent of air pollution depends heavily on how weather disposes of the pollutants. The ability of the atmosphere to dilute and disperse them is limited to two factors—wind speed and the depth in the atmosphere to which air near the surface can be mixed. Although considerable variation occurs from day to day in the extent to which these factors disperse air pollution, the same patterns tend to repeat themselves over months or years. On some few days in a year, strong winds and highly unstable atmospheric conditions may disperse even the heaviest blanket of pollution. On many other days, weak winds and highly stable conditions let small quantities of pollutants accumulate and build up to serious proportions. Between these extremes, variations in weather conditions create varying levels of pollution over a given area.

Many cities lie in natural basins at the confluence of rivers, around bays, or in flat areas backed against mountains. Such basins are natural gathering places for low-lying masses of warm air, which trap pollutants in the familiar phenomenon known as an "inversion." However, even communities more favorably located increasingly find that atmospheric conditions limit the amount of air available as a dumping place for pollutants.

. . . to Human Health

The most important effect of air pollution is its threat to human health. Acute episodes of pollution in London, New York, and other cities have been marked by dramatic increases in death and illness rates, especially among the elderly and those with preexisting respiratory or cardiac conditions.

The incident most familiar to Americans occurred in 1948 in Donora, an industrial town in the mountains of western Pennsylvania. Almost half of the town's 14,000 inhabitants fell ill; 20 died. The worst air pollution disaster of modern times struck in London in 1952 when its famous "killer smog" increased the number of deaths in London to 1,600 more than would have normally occurred. Both of those episodes occurred when, under conditions lasting for several days, unusual weather prevented the dispersal of pollutants.

Such major disasters are cause for concern. However, of much greater significance for the American population are the subtle, long-range effects on human health of exposure to low-level, long-lasting pollution.

The causes of chronic diseases which constitute the major public health problems of our time are difficult to determine. Assessing the contribution of particular pollutants to these conditions is complicated by the seemingly infinite variety of pollutants to which persons, particularly those in urban areas, are exposed from the day of their birth. And it is difficult to separate pollution from the other biological and physical stresses to which people are subjected.

Nonetheless, it is well established that air pollution contributes to the incidence of such chronic diseases as emphysema, bronchitis, and other respiratory ailments. Polluted air is also linked to higher mortality rates from other causes, including cancer and arteriosclerotic heart disease. Smokers living in polluted cities have a much higher rate of lung cancer than smokers in rural areas.

The incidence of chronic diseases has soared sharply during this century, while the infectious diseases which were the primary public health concern in the past have been brought under control. Heart and blood vessel diseases caused more than half the deaths in the United States in 1962. Lung cancer, once a rarity, now kills more persons than all other cancer types combined. Emphysema has doubled every 5 years since World War II. Air pollution has been linked to asthma, acute respiratory infections, allergies, and other ailments in children. Such childhood diseases may well underlie chronic ills developed in later life.

Knowledge of the health effects of specific contaminants present in the air is far from complete. However, the more overt health effects of several major classes of pollutants are beginning to be defined. Those pollutants are found almost everywhere in the United States.

When *carbon monoxide* is inhaled, it displaces the oxygen in the blood and reduces the amount carried to the body tissues. At levels commonly found in city air, it can slow the reactions of even the healthiest persons, making them more prone to accidents. Moreover, it is believed to impose an extra burden on those already suffering from anemia, diseases of the heart and blood vessels, chronic lung disease, overactive thyroid, or even simple fever. Cigarette smokers, who are already inhaling significant amounts of CO in tobacco smoke, take on an additional CO burden from polluted air.

Studies show that exposure to 10 parts per million of CO for approximately 8 hours may dull mental performance. Such levels of carbon monoxide are commonly found in cities throughout the world. In heavy traffic situations, levels of 70, 80, or 100 parts per million are not uncommon for short periods.

Sulfur oxides, produced mainly by burning coal and oil, can cause temporary and permanent injury to the respiratory system. When particulate matter is inhaled with the sulfur oxides, health damage increases significantly. The air pollution disasters of recent years were due primarily to sharply increased levels of sulfur oxides and particulates.

Sulfur dioxide can irritate the upper respiratory tract. Carried into the lungs on particles, it can injure delicate tissue. Sulfuric acid—formed from sulfur trioxide when water is present—can penetrate deep into the lungs and damage tissue.

Health may be imperiled when the annual mean concentration of sulfur dioxide in the air rises above 0.04 parts per million. Deaths from bronchitis and from lung cancer may increase when this level of sulfur dioxide is accompanied by smoke concentrations of about 0.06 parts per million. American cities often exceed this annual mean substantially. The annual mean concentration of SO_2 in the air was 0.12 parts per million in Chicago in 1968; in Philadelphia it was 0.08. When SO_x exceeds 0.11 parts per million for 3 to 4 days, adverse health effects have been observed, and this level is reached in many large cities during inversions.

Photochemical oxidants have emerged relatively recently as a major health problem, and research relating to their effects on human health is still in its infancy. However, studies have shown that eye irritation begins when peak oxidant levels reach 0.10 parts per million. Increased frequency of asthma attacks occurs in some patients on those days when hourly concentrations average 0.05 to 0.06 parts per million. Even the healthiest persons may be affected, however; a study of cross-country runners in a Los Angeles high school showed that their performances suffered when hourly average oxidant levels ranged from 0.03 to 0.30 parts per million.

Less is known about the effects on health of *nitrogen oxides*, which play such an important part in producing photochemical pollution. They have been little studied until recently. However, evidence so far suggests that they may be harmful to human health. A study in Chattanooga, Tenn., linked very low levels of these oxides in the air to children's susceptibility to Asian flu.

The lowest *particulate levels* at which health effects have been noted in the United States were reported at Buffalo. The Buffalo study suggests that the overall death rate rises in areas with an annual average concentration ranging from 80 to 100 micrograms per cubic meter. The study also reveals a tie between these levels of particulate matter and gastric cancer in men 50 to 69 years old. A similar association was found in a Nashville study. Particulate levels in this range are found in most major urban areas and are common even in smaller industrial cities.

The findings relating to particulate matter, as a class of pollutants, amply justify measures to reduce their level in the air. Included in this class of pollutants are a number of substances which are potential health hazards at much lower concentrations and which will require even more stringent controls.

Beryllium, for example, which may be emitted from industrial sources and from rocket fuel, can cause lesions in the lung, producing serious respiratory damage and even death. Since the sources of this pollutant are limited, however, it may be a problem only in specific localities.

Asbestos, long recognized as an occupational hazard, is increasingly present in the ambient air because of its use in construction materials, brake linings, and other products. Long exposure in industry produces the lung-scarring disease, asbestosis. On the other hand, mesothelioma, a type of lung cancer associated almost exclusively with asbestos exposure, does not appear to be associated only with heavy or continued exposure.

Many other particulate pollutants are a growing public health worry even though they may not constitute such an immediate and direct threat. Current studies suggest that lead levels now found in the blood and urine of urban populations—although well below those associated with classic lead poisoning—may interfere with the ability of the human body to produce blood. As air pollution becomes more widespread, increased numbers of people are being exposed to airborne lead, chiefly from automotive emissions, at levels formerly found only in congested areas.

. . . *to Vegetation and Materials*

Air pollution inflicts widespread and costly damage on plant life and buildings and materials. Some experiences of the past warned of the effects of air pollution on plant life. Sulfur dioxide fumes from a large copper smelting plant set up after the Civil War in Copper Basin, Tenn., damaged 30,000 acres of timberland. Much of this originally forested mountain land is still barren. Today, the damage to plant life is less dramatic than in the days of unrestricted smelter operations. But the slower, chronic injury inflicted on agricultural, forest, and ornamental vegetation by increasing quantities and varieties of air pollutants has now spread to all parts of the country.

Smog in the Los Angeles basin contributes to the slow decline of citrus groves south of the city and damages trees in the San Bernardino National Forest 50 miles away. Fluoride and sulfur oxides, released into the air by phosphate fertilizer processing in Florida, have blighted large numbers of pines and citrus orchards. Livestock grazing on fluoride-tainted vegetation develop a crippling condition known as fluorosis. In New Jersey, pollution injury to vegetation has been observed in every county and damage reported to at least 36 commercial crops.

At sulfur oxide levels routinely observed in some of our cities, many plants suffer a chronic injury described as "early aging." Nitrogen dioxide produces similar injury symptoms and seems to restrict the growth of plants even when symptoms of injury are not visible. Ozone, a major photochemical oxidant, is a significant threat to leafy vegetables, field and forage crops, shrubs, and fruit and forest trees—particularly conifers. The damage from ozone in minute quantities can be great. Extended ozone exposure to 0.05 parts per million can reduce a radish yield 50 percent. Tobacco is sensitive to ozone at a level of 0.03 parts per million.

Air pollutants also damage a wide variety of materials. Sulfur oxides will destroy even the most durable products. Steel corrodes two to four times faster in urban industrial areas than it does in rural areas where much less sulfur-bearing coal and oil are burned. When particulate matter is also present in the air, the corrosion rates multiply. One-third of the replacement cost of steel rails in England is estimated to be caused by sulfur pollution. The rise of sulfur oxides levels in the air is accelerating the erosion of statuary and buildings throughout the world, and in some cities, works of art made of stone, bronze, and steel must be moved indoors to preserve them from deterioration. Particulate matter in the air not only speeds the corrosive action of other pollutants but by itself is responsible for costly damage and soiling. Clothes and cars must be washed, houses painted, and buildings cleaned more often because of the particulates in the air. Ozone damages textiles, discolors dyes, and greatly accelerates the cracking of rubber.

. . . to Visibility

Air pollution dims visibility, obscures city skylines and scenic beauty, interferes with the safe operation of aircraft and automobiles, and disrupts transportation schedules. In one recent year, low visibility from smoke, haze, and dust was the suspected cause of 15 to 20 plane crashes. In Los Angeles, visibility in the smog frequently lowers to less than 3 miles. During the air pollution alert in the Eastern States during July 1970, visibility was almost totally obscured in some areas. The Federal Aviation Administration's visibility safety factor for airplane operation without instruments is 5 miles. Nitrogen dioxide, which reaches peak levels during morning rush-hour traffic, is responsible for the whiskey-brown haze that stains the sky over many cities. Particulates, however, are the major villain in reducing visibility. Particles (ash, carbon, dust, and liquid particles) discharged directly to the air scatter and absorb light, reducing the contrast between objects and their backgrounds. Particles are also formed in the atmosphere by photochemical reactions and by the conversion of sulfur dioxide to sulfuric acid mist. Wherever sulfur pollution is significant—which is wherever large amounts of coal and oil are burned—visibility diminishes as relative humidity rises.

. . . to Climate

Air pollution alters climate and may produce global changes in temperature. Chapter V of this report deals with that subject.

WHAT AIR POLLUTION COSTS

. . . in Damages

The total costs of air pollution in the United States cannot be precisely calculated, but they amount to many billions of dollars a year. Economic studies are beginning to identify some of the more obvious costs. To paint steel structures damaged by air pollution runs an estimated $100 million a year. Commercial laundering, cleaning, and dyeing of fabrics soiled by air pollution costs about $800 million. Washing cars dirtied by air pollution costs about $240 million. Damage to agricultural crops and livestock is put at $500 million a year or more. Adverse effects of air pollution on air travel cost from $40 to $80 million a year. Even more difficult to tie down are the costs of replacing and protecting precision instruments or maintaining cleanliness in the production of foods, beverages, and other consumables. It is equally difficult to assess damage, soiling, and added maintenance to homes and furnishings or how air pollution acts on property values. The cost of fuels wasted in incomplete combustion and of valuable and potentially recoverable resources such as sulfur wasted into the air is also hard to count. It is still more difficult to determine the dollar value of medical costs and time lost from work because of air pollution—or to calculate the resulting fall in productivity of business and industry.

. . . in Control

The total investment necessary through 1975 to control the major industrial and municipal sources of particulate matter, sulfur oxides, hydrocarbons, and carbon monoxide in 100 metropolitan areas of the United States has been estimated at $2.6 billion. This includes costs for controlling both existing and new sources. By 1975, it will cost another $1.9 billion for operation, maintenance, depreciation, and interest.

These estimated costs are based on assumed future control requirements. Still, the yearly cost to control the industrial sources of these four major pollutants is relatively low, less than 1 percent of the value of the annual output of the industries involved, although the costs to some industries is much greater.

According to industry estimates, the costs of control devices to meet Federal motor vehicle emission standards are rising rapidly, both because of general increases in prices and because of the increasing stringency of the standards. The cost for 1968 and 1969 models was $18–19 per car; for 1970, $36 per car; and for 1971 models it is estimated at $49 per car. The application of more stringent standards will increase these costs still further. Thus in 1971 the cost for installing control devices on the 10 million new cars produced will be almost $500 million. However, assuming that the average vehicle life is 10 years, the cost is only $5 per car per year.

PROGRAMS IN AIR POLLUTION CONTROL

Legislative History

The first Federal legislation concerned exclusively with air pollution was enacted in July 1955. It authorized $5 million annually to the Public Health Service of the Department of Health, Education, and Welfare for research, data collection, and technical assistance to State and local governments.

Pressures for action led to the Clean Air Act of 1963. It provided grants to air pollution agencies for control programs (with special bonuses for intermunicipal or interstate areas). And it provided Federal enforcement authority to attack interstate air pollution problems.

In October 1965, the Clean Air Act was amended to permit national regulation of air pollution from new motor vehicles. The first standards were applied to 1968 models. These standards were tightened for 1970 and 1971 model cars. And even more stringent standards have been announced for 1973 and 1975.

In November 1967, the Congress passed the comprehensive Air Quality Act, which undergirds much of the current Federal air pollution control effort. That act set in motion a new regional approach to establishing and enforcing Federal-State air quality standards:

- The Secretary of HEW first must designate air quality control regions within a State or within an interstate region.
- The Secretary must promulgate air quality criteria which, based on scientific studies, describe the harmful effects of an air pollutant on health, vegetation, and materials. He must issue control technology documents showing availability, costs and effectiveness of prevention and control techniques.

- In the designated regions, the States must show willingness to establish air quality standards.
- The States then set standards limiting the levels of the pollutant described in the criteria and control technology documents. If the States fail to do this, the Secretary is empowered to set the standards.
- After the States have developed air quality standards, they must establish comprehensive plans for implementing them. (These plans should set specific emission levels by source and a timetable for achieving compliance.)

The process of adopting standards and implementation plans can take up to a year and a half, and the approval process requires still more time. The process must be renewed and repeated each time criteria and control techniques are issued for a new pollutant.

On February 10, 1970, the President made a number of legislative proposals to improve the air quality program. Among them were proposals to apply air quality standards throughout the entire Nation, not just within the air quality control regions. Hearings are provided for, and the States have the option of adopting more stringent standards if they choose. The States would have 9 months from the time the national standards are established to submit a plan detailing how they would enforce the national standards, including the associated emission standards. The Federal Government would enforce the standards if the air quality in a State or region fell below the standards and the State plan was not being carried out. The provisions for national standards should markedly quicken the process of establishing enforceable standards and a workable plan for abatement.

The President's proposals also call for national emission standards for new pollutant sources considered harmful to health and welfare and which can be controlled. This authority is necessary to insure that new stationary sources are designed to reduce emissions to the lowest level consistent with available technology. National emission standards would apply to existing as well as to new stationary sources for pollutants extremely hazardous to health, such as asbestos, cadmium, or beryllium. The legislation would authorize the Secretary of HEW to move directly against sources of these pollutants when States do not act.

The President's program would also extend Federal enforcement authority to pollution within one State. And it would levy fines of up to $10,000 a day for noncompliance.

The Department of HEW first issued documents on air quality criteria and control methods for sulfur oxides and particulate matter in February 1969. This triggered the standards-setting process for these two key pollutants. In March 1970, criteria and control documents were issued for carbon monoxide, hydrocarbons, and photochemical oxidants. HEW expects to issue documents on lead, nitrogen oxides, flourides, and polynuclear organic compounds early in 1971.

By July 1, 1970, air quality regions had been designated in 40 major metropolitan areas. By the end of the summer 1970, HEW expects to designate 90 regions, providing at least one region in each State. These regions will embrace 123 million people, almost 60 percent of the U.S. population. As of July 1, 1970, 17 States had submitted standards to the Department, and 10 had been approved. No implementation plans have yet been approved.

Action on each new pollutant requires publication of air quality criteria and control technology, the development and approval of State standards for each region, and the development and approval of State implementation plans for each region. The National Air Pollution Control Administration (NAPCA) is currently studying 30 different pollutants to determine their potential effects on health. When the evaluations are completed, criteria documents will be issued, as necessary.

Federal Abatement Actions

Although the major current emphasis is on developing standards, some action continues under the enforcement provisions of the 1963 Clean Air Act. Since passage of the act, 10 enforcement conferences have been held. Four have dealt with single sources of pollution; six have considered all sources of pollution within major metropolitan areas, including the metropolitan areas of New York-New Jersey, Kansas City, and Washington, D.C.

Those conferences covering whole metropolitan areas have concentrated more on strengthening State and local efforts than on directly curbing polluters. The conference-public hearing procedure has been a cumbersome and time-consuming method of taking action against individual polluters.

The first air pollution enforcement action was instituted in 1965 against a chicken rendering plant in Bishop, Md. A conference was held in 1965 and a public hearing in 1967; a suit was begun in the Federal district court in 1969, and an appeal finally made to the U.S

Supreme Court. The plant was not shut down until the Supreme Court refused to hear the appeal in May 1970—5 years after the action started. No other enforcement action has proceeded beyond the conference stage.

No enforcement has yet taken place under the 1967 act, since the standards, for the most part, have not yet been adopted nor implementation plans approved. The President has submitted comprehensive proposals to the Congress to strengthen enforcement powers. These are discussed later in the chapter.

Curbing Auto Pollution

The first standards set under the 1965 Amendments to the Clean Air Act applied to 1968 model vehicles. These standards required complete control of crankcase hydrocarbons and partial control of exhaust hydrocarbons and carbon monoxide.

In June 1968, HEW tightened exhaust standards for 1970 and later model vehicles and for the first time set evaporative loss standards—to be applied starting with the 1971 model year.

In July 1970, the Secretary proposed sweeping changes in procedures for testing whether new automobiles meet the Federal emission standards—when it was discovered that the existing procedures underestimated the actual amount of pollution being emitted. The new test procedures would take effect when prototypes of 1972 model cars begin their tests at the end of this year. At the same time, the Secretary confirmed the same 1975 standards for hydrocarbons and carbon monoxide and said that the nitrogen oxide and particulate standards proposed in February 1970 would be confirmed as soon as test procedures for these standards had been developed. Table 2 summarizes the effects of all these standards on automobile emissions through 1975.

Under the 1965 Amendments to the Clean Air Act, NAPCA tests only vehicles submitted by a manufacturer. If the test vehicle meets the Federal standards, all other like model vehicles sold by a manufacturer are deemed in conformity with the standards.

The first surveillance data on production line cars subject to the Federal standards were reported in the summer of 1968. The data showed that, on the average, the cars complied with the Federal standards. However, by the winter of 1969, the surveillance data showed that, on the average, hydrocarbon emissions of 1968 cars ran about 20 percent above the standard and carbon monoxide emissions about 8 percent above. Reports in 1970 show hydrocarbon emissions higher than the standard by 25 percent and carbon monoxide by about 10 percent.

TABLE 2.—*Exhaust Emission Standards and Uncontrolled Vehicle Emission Levels Based on Current and Proposed 1972 Test Procedures*

PRESENT TEST PROCEDURE

	Hydrocarbons		Carbon monoxide		Oxides of nitrogen		Particulates	
	G./mi.[1]	Percent[2]	G./mi.	Percent	G./mi.	Percent	G./mi.	Percent
Baseline (uncontrolled vehicle)	11.2	--------	73.0	--------	--------	--------	--------	--------
Present standards (intended degree of control)	2.2	80	23.0	69	N.A.[3]	N.A.	N.A.	N.A.
1975 standards (expected control)	.5	96	11.0	86	--------	--------	--------	--------
PROPOSED TEST PROCEDURE								
Baseline (uncontrolled vehicle)	14.6	--------	116.3	--------	6.0	--------	0.3	--------
Equivalent present standards (achieved degree of control)	4.6	69	47.0	60	--------	--------	--------	--------
Proposed 1972 Standards (control)	2.9	80	37.0	69	--------	--------	--------	--------
Proposed 1973 standards (control)	--------	--------	--------	--------	3.0	50	--------	--------
Proposed 1975 standards (control)	.5	97	11.0	91	.9	85	.1	66.7

[1] Grams per mile emitted.
[2] Percentage reduction from uncontrolled vehicle.
[3] No standards applicable.
Source: NAPCA.

Remedies for the failure of production line cars to perform as well as their prototypes are both administrative and legislative. New tests to be applied for the first time to 1972 models include a revised durability test. It will more accurately reflect actual operating conditions. And the manufacturer will be required to make available to NAPCA test cars to be under the control of the Federal Government in accumulating durability mileage.

Proposed Presidential amendments to the Clean Air Act would authorize HEW to withdraw approval of a particular model of car if vehicles coming off the production lines do not meet the Federal standards. Moreover, the Secretary of HEW would be explicitly authorized to test, or require manufacturers to test, vehicles at the end of production lines. Even with these safeguards, many automobiles will not meet the standards. In addition to systems that break down or are not sufficiently durable, the car owner may not provide proper maintenance.

The data on present levels of pollution in our urban environment, the projected increase in urban traffic in the years ahead, and the performance of pollution control systems under actual driving conditions make it clear that even applying stricter standards in 1975 will only prolong the downward curve in vehicle emissions until the middle 1980's. After that, carbon monoxide levels will again rise because of the sheer number of automobiles on the roads and highways.

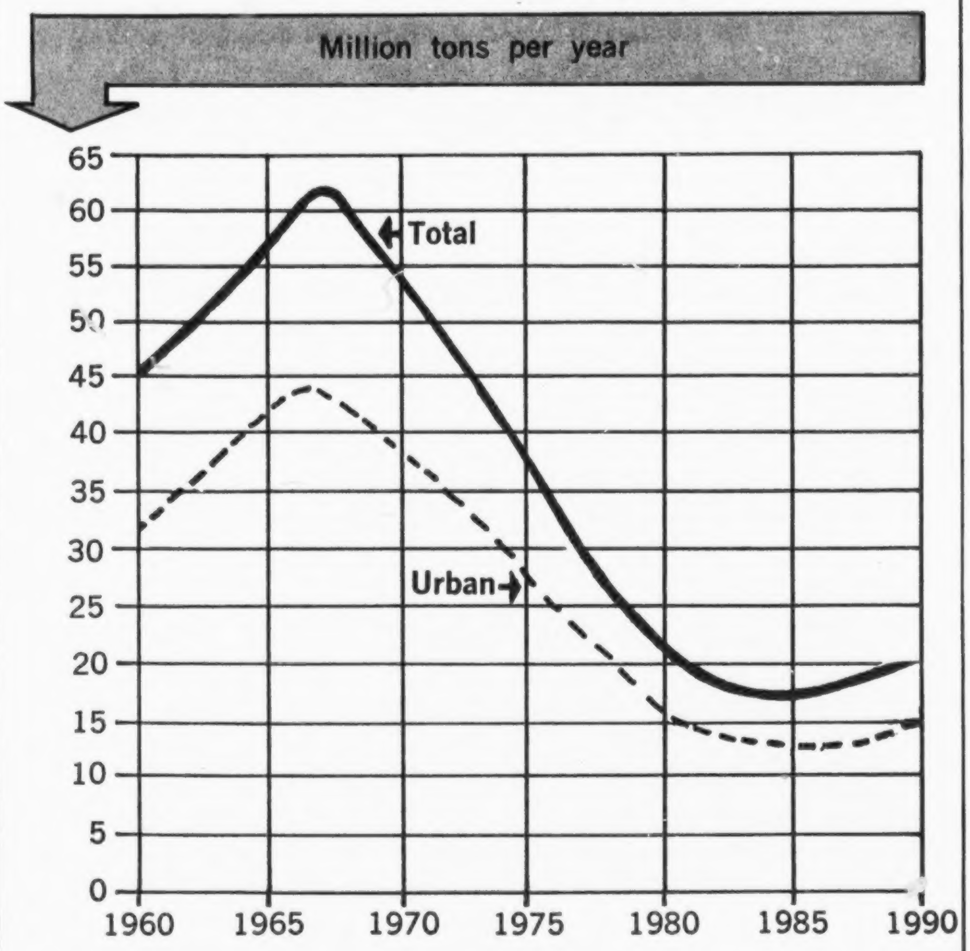
Motor vehicle pollution is the product of a complex combustion system of engines, fuels, and fuel additives. Effective control, then, means dealing not only with engines and control devices but with the fuel itself and with fuel additives. The President's proposed legislation includes authority to establish standards and regulations for both fuel and fuel additives.

The key additive from an air pollution control viewpoint is tetraethyl lead in gasoline. It accounts for a significant portion of the particulate pollution from automobiles. Most experts believe that control systems incorporating chemical catalysts will be required to meet 1975 standards. Experience to date indicates that lead in gasoline poses serious problems to the use of catalytic control devices. Although other control methods are likely to be available, the catalyst appears to be most economical and durable. A panel of the Commerce Technical Advisory Board concluded that lead-free gasoline should be ready within the next few years so that industry will have the chance to road-test these catalytic devices. Automobile manufacturers say that they intend to market vehicles with low-octane requirements in their 1971 models, thus reducing or even eliminating the need for lead in gasoline.

The Secretary of HEW has asked the chief executives of the Nation's petroleum companies to work toward production of a lead-free gasoline. The Secretary suggested a plan to reduce lead levels in regular grades to 0.5 gram per gallon by July 1, 1971, and to zero lead content by July 1, 1974. However, since premium gasoline containing lead will still be needed for a number of years to meet the requirements of high compression engines in older cars, the Secretary's plan provides for leaded premium gasoline as long as it is needed. To make the new gasolines competitive, the administration has requested a $4.25 per pound tax on lead used in gasoline.

An alternative to the internal combustion engine may be necessary if it cannot meet the increasingly stiff standards. The President announced in his February 10, 1970, environmental message a program to develop one or more alternatives within 5 years. He called for:

Carbon Monoxide Emissions by Motor Vehicles in the United States, 1960–90



Projections based on proposed
1973 and 1975 Federal Standards

Source: National Air Pollution Control Administration, HEW.

- An extensive research and development program to be conducted under the general direction of the Council on Environmental Quality;
- An incentive program to private developers, through Government purchase of privately produced unconventional vehicles for testing and evaluation.

Controlling Sulfur Oxides

Sulfur oxides are one of the most difficult classes of air pollutants to control. Because of their toxicity and pervasiveness, they are among the most dangerous air pollutants to human health and are clearly the most harmful to vegetation, buildings, and materials. Because their source is chiefly the electric power industry, their potential increase is tied to that burgeoning industry, which almost doubles its output every 10 years.

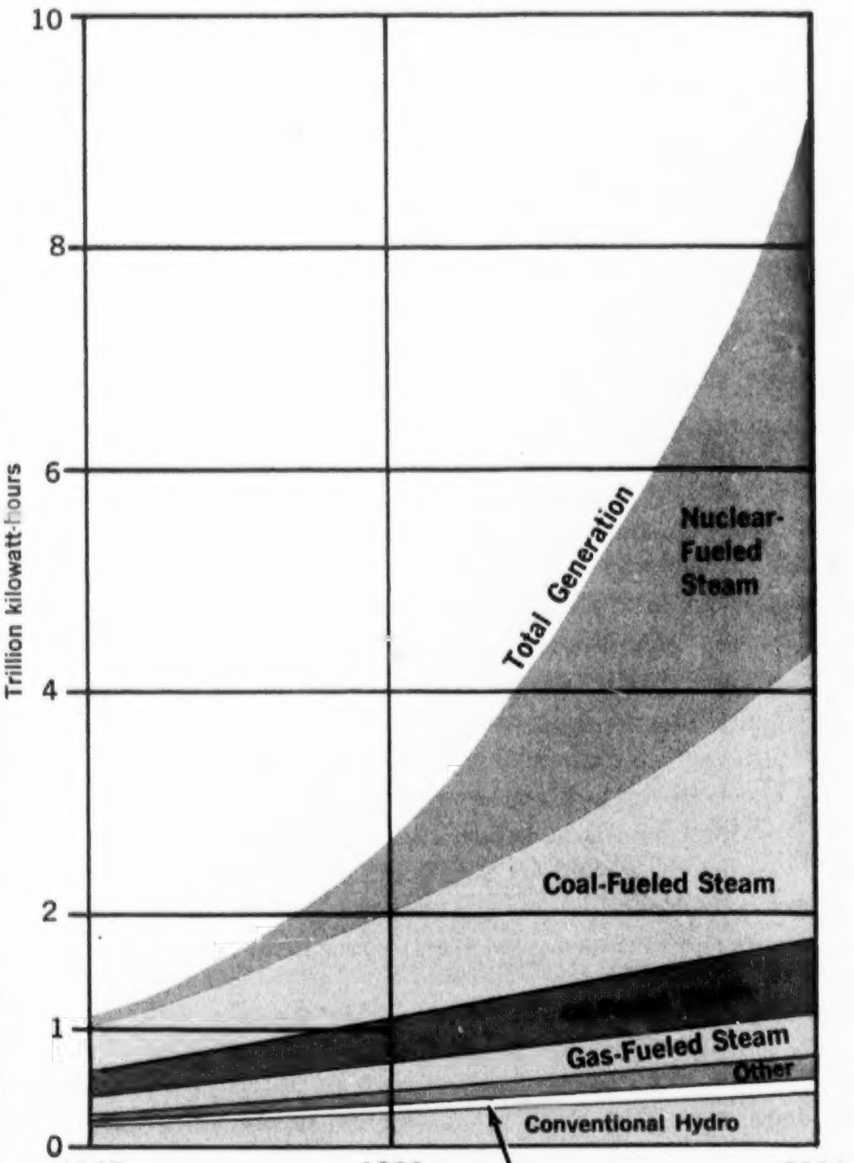
At present about 65 percent of the energy for generating electricity stems from coal; gas, oil, and hydroelectric sources account for about 34 percent; and nuclear energy the remaining 1 percent. By 1980, 22 percent of the total installed electric power capacity is expected to be nuclear. By 1990, it will be 40 percent. However, by far the greatest source of energy is now, and will continue to be for the rest of this century, the burning of coal and oil. The amount of coal used for power by the year 2000 will be four times greater than it is today.

A number of alternatives are available to control sulfur oxide pollution over the next decade. Switching fuels is possible, but only when an alternative, low-sulfur fuel is available. Most coal near the Nation's centers of population and power demand is high in sulfur. Low-sulfur coal not only is far away but also commands a higher price for use as coke by domestic and foreign steelmakers. North Africa and other areas are rich in low sulfur oil but are limited by low production and refinery capabilities. Oil import quotas bar it from certain areas of the Midwest and the West Coast, although the oil may be imported to other areas of the United States. The United States will probably continue to rely primarily on residual oil from the Western Hemisphere. And that oil will have to be desulfurized before it is used. Natural gas carries an insignificant sulfur content, but it is the scarcest of fossil fuels, and most of it is being conserved for nonpower purposes.

Sulfur can be separated from coal and oil, but the processes are costly, and some are not fully developed technically. Methods to remove sulfur from the stack gases after the fuel is burned are under

Projected Electric Generation by Source 1965–2000

Annual average generation



Sources: Water Resources Council; Bureau of Mines, Department of the Interior.

development. However, none of these processes is yet in large-scale use and the costs are not yet known. Some of the stack control processes recover sulfur or a sulfur byproduct, which can be sold to help offset costs. Some are also being evaluated for their potential in reducing pollution from nitrogen oxides.

Research and Development

A number of technological and research gaps in controlling air pollution still exist. NAPCA carries on an extensive research, development, and demonstration program in its own facilities and through grants and contracts. The fiscal year 1970 budget contains $59.3 million in budgeted funds for research and demonstration. The fiscal year 1971 budget requests call for $63.3 million.

Two principal areas hold high priority. One is the development of technology for the control of stationary sources. Currently, a comprehensive program is underway in NAPCA, working with the Bureau of Mines and TVA, aimed at perfecting techniques for controlling sulfur oxides. A similar program is getting underway for nitrogen oxides. The second prime priority is the development of new low-emission power systems for motor vehicles. This program aims to develop at least two unconventional vehicle prototypes and to demonstrate commercial feasibility by 1975. Initial research will center on gas turbine, steam, and hybrid systems, with continued work on electrical systems. The 1971 Federal Budget sets aside $9 million for this program. The Council on Environmental Quality has worked closely with the Department of Health, Education, and Welfare, which is the lead agency for this program, and with other Federal agencies to assure that the widest range of Federal talents is enlisted in the low-emission power program. The Council has also appointed a committee to advise it on this program, headed by Dr. Ernest Starkman, of the University of California at Berkeley.

Air Quality Monitoring

Collecting and evaluating data on air pollutant emissions and air quality require a joint Federal-State-local effort. NAPCA is now engaged not only in operating its own air monitoring network but also in supporting State and local monitoring activities. NAPCA's own air monitoring program involves operation of more than a thousand air sampling devices at stations across the country, including six continuous monitoring stations in major cities. Over the past year, mechanized devices for measuring various gaseous pollutants were put in operation at 145 sites. This expansion of NAPCA's network reflects the increased stress on gathering data for air pollutants which have been or will be the subject of air quality criteria documents.

State and local governments, which have the primary responsibility for monitoring air quality, operate over 2,000 stations. Most of them, however, monitor air quality only intermittently.

State and Local Programs

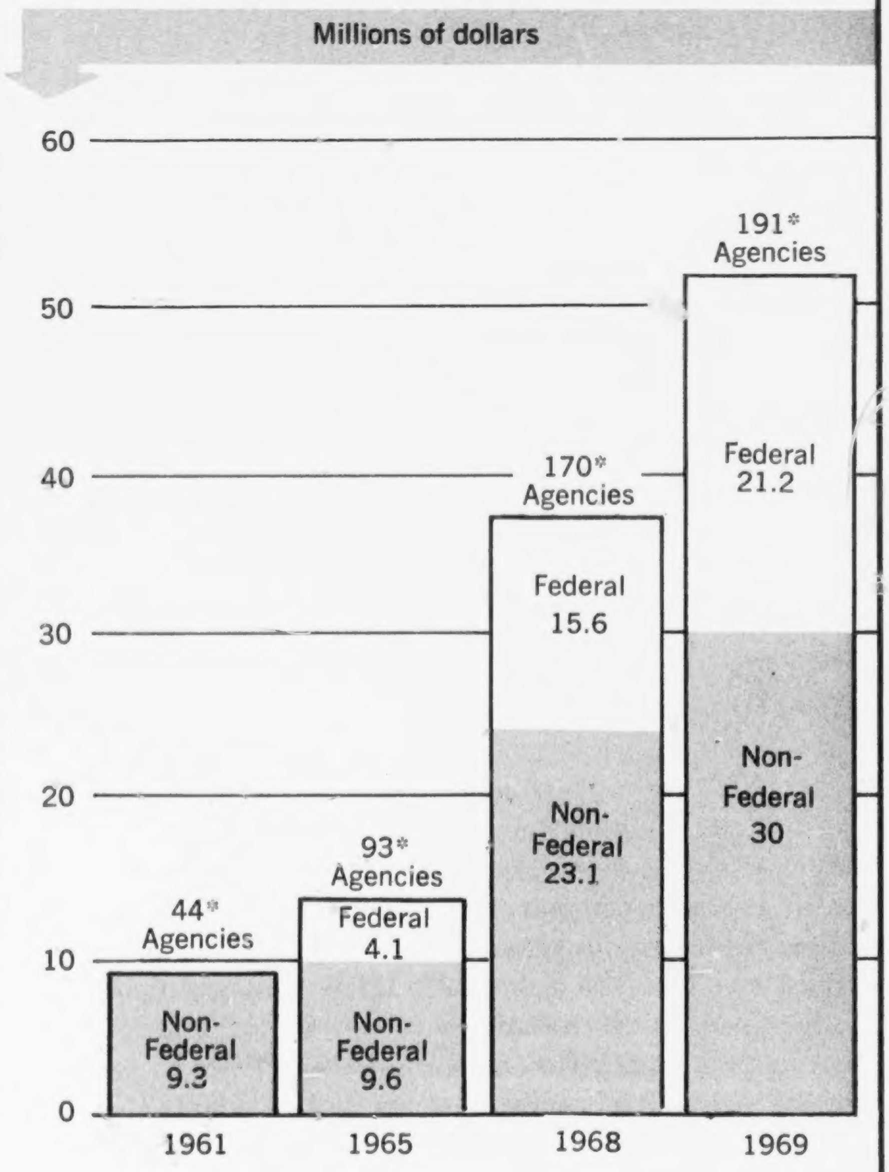
With one major exception—new motor vehicles, whose control the Clean Air Act preempts to the Federal Government—primary responsibility for the control of the sources of air pollution is assigned to State and local governments. An assessment, then, of State and local air pollution control programs is a useful measure of the current efforts to cope with the problem.

A March 1970 Department of Health, Education, and Welfare report to the Congress, "Progress in the Prevention and Control of Air Pollution," traces the considerable increase in State and local budgets for air pollution control, stimulated in large part by the Federal matching grants program initiated in 1963. However, of the 55 State and territorial programs being financed by the grants program in 1970, only six have reached an annual per capita expenditure of 25 cents, which is generally considered the minimum expenditure needed for State programs. Only 23, including the six, are spending as much as 10 cents per person per year. At the local level, the situation is better: 64 of 144 grantee agencies are spending at least 40 cents per capita per year, which is generally considered the minimum needed for local programs.

Table 3, also from the March 1970 HEW progress report, shows the accelerated pace at which States have been adopting air pollution control regulations during the last several years. Prior to passage of the Clean Air Act in 1963, only nine States had adopted air pollution control regulations. By 1967–68, 30 had. By the end of 1970 it is expected that all States will have established the legal basis for controlling the sources of air pollution.

No detailed survey has been made of the adoption of air pollution regulations at the local level of government. However, local agencies set up to deal with the problem have proliferated—from 85 agencies in 1962 to more than 200 today.

Budgets of State, Local and Regional Air Pollution Control Agencies, Fiscal Years 1961–69



*Number of Agencies: Totals for 1961 represent all agencies in existence at that time; Totals for subsequent years represent all agencies receiving Federal grant support.

Source: National Air Pollution Control Administration, HEW.

TABLE 3.—*State Laws and Regulations*

[Number of States enacting laws and regulations in specified years]

	1951–62	1963–64	1965–66	1967–68	Total
Initial law enacted	11	3	9	23	46
First regulation adopted	9	----------	4	17	30
Type of regulation:					
Administrative	9	----------	4	13	26
Fuel burning	2	----------	3	11	16
Open burning	4	----------	3	12	19
Ambient standards	2	1	1	11	15
Visible emissions	5	----------	3	14	22
Incinerator	1	1	2	13	17
Industrial process	----------	1	4	9	14
Vehicle	1	----------	----------	5	6
Sulfur oxides	----------	----------	1	5	6

Perhaps the most significant indicator of the adequacy of State and local air pollution control programs is manpower. The 1970 HEW report to the Congress, "Manpower and Training Needs for Air Pollution Control," indicates that in general control agencies are inadequately staffed. Fifty percent of State agencies have fewer than 10 positions budgeted, and 50 percent of local agencies have fewer than seven positions budgeted. Further, during 1969 the vacancy rate for all agencies was 20 percent. Recruitment of competent personnel is difficult. The report estimates that by 1974 State and local agencies will need 8,000 personnel if they are to implement the Clean Air Act properly—a jump of 300 percent over the number of persons currently employed in these programs.

The chief difficulty is the low salary rates paid by State and local agencies. The HEW report cites a study which indicates that State and local median salaries fall 20 to 50 percent below the median paid by industry for comparable positions.

EVALUATION

In evaluating the effectiveness of air quality efforts, it is useful to separate stationary from mobile sources, since the methods of control and the implementing institutions are so different. It is also useful, for purposes of perspective, to compare air quality and water quality efforts on stationary sources, since many aspects of the Federal legislation are similar.

Stationary Sources

Congressional and public concern focused on water pollution many years before air pollution. The first permanent water pollution legislation was enacted in 1956, the first permanent air pollution legislation not until 1963. There are currently standards and implementation plans for almost all the interstate and coastal waters of the United States, covering most forms of water pollution. Water quality criteria have been developed, and Federal, State, and local governments and industry are beginning to commit themselves to abatement programs.

In contrast, only five air pollution criteria have been issued; only 10 State standards have been approved; and no State implementation plans have yet been approved. There is currently no basis for enforcing standards, because enforcement must await approval of implementation plans.

The air pollution effort is not as advanced as water pollution in terms of stationary sources for three major reasons. First, there is no available technology for a number of air pollutants, although most forms of industrial water pollution are amenable to control. Second, State water pollution control agencies have existed for many years in the United States and have developed capabilities, although often limited. Until enactment of the Air Quality Act of 1967, air pollution control was largely conducted by local agencies. Few States had adequate manpower and resources. Finally, the Air Quality Act of 1967 is no longer an adequate tool to cope with current pollution problems. Procedures for development and implementation of air quality standards are too slow and place an inordinate burden on both the States and the Federal Government.

The current enforcement authority is also inadequate. As with water pollution, the Federal Government has no jurisdiction if the pollution from one State is not endangering health and welfare in another State, unless the Governor of the State in which the pollution occurs requests help. The current conference-hearing procedure is unduly cumbersome and time consuming. The only court action that can be requested by the Government against a polluter is a cease-and-desist order, and the only available remedy in the case of noncompliance is to hold the polluter in contempt of court. The current act does not provide for fines to compel compliance.

Mobile Sources

The attack on pollution from automotive emissions has begun to make progress. Current standards have already reduced emissions, and the 1973 and 1975 standards are expected to bring a further marked decrease. As discussed earlier, however, control systems on vehicles sold to the public lose their effectiveness more rapidly than on test vehicles, and, accordingly, the goals may not be met. Also, the current program does not deal with the millions of cars on the road with no control systems at all or with systems that do not or will not meet the required standards.

Monitoring

Although air pollution monitoring has been underway for years, the current systems—Federal, State, and local—are so spotty in coverage that it is very difficult to determine trends in the quality of air. For example, sampling stations are generally in downtown areas. The deterioration of air quality away from these regions, where the greatest amount of industrialization and urbanization has been taking place, is often not even monitored. Often trend data indicate improvement in one pollutant, while other pollutants not measured in the same city are increasing. Clearly, the total level of pollutants in our major urban areas continues to be above levels at which adverse effects on human health and destruction of vegetation, buildings, and materials occur. But improved monitoring systems are necessary to understand the status and trends in air quality and to develop better control programs.

State and Local Programs

As discussed earlier, until enactment of the Air Quality Act of 1967, air pollution was carried on largely by local agencies. The expenditures by State government were only $1.1 million in 1961. Even under the stimulation of Federal grants, State air pollution control agencies spent only $9.6 million in 1970, compared to $17.2 million for local air pollution control agencies and about $36 million for State water pollution agencies.

NAPCA considers inadequate some 28 to 34 State programs for areas not under the jurisdiction of a local agency. Some 14 to 20 are considered adequate or progressing rapidly, and only two to four are considered good. Local and regional programs are doing better, with 44 percent of the agencies spending what NAPCA considers adequate for a minimal program.

WHAT NEEDS TO BE DONE

The Council on Environmental Quality recommends the following:

1. *The President's legislative program should be enacted to deal more effectively with stationary sources by setting national air quality standards and national emission standards on substances harmful to health, by streamlining enforcement procedures, and by providing fines of up to $10,000 a day.*

2. *If the President's legislative program is enacted, the major Federal efforts on stationary sources should be directed toward the prompt establishment of national air quality standards covering a wide range of pollutants, and toward development of emission control limits for harmful pollutants such as asbestos, beryllium, cadmium, and other toxic materials.*

3. *Programs must be developed to improve State and local control agencies.* Highest priority should be given to increasing personnel, monitoring, and other control and enforcement activities. The recently developed program of assigning Federal personnel to the agencies is a positive step. But greatly expanded training efforts and higher pay are necessary to provide the personnel needed for effective air quality management.

4. *Federal research and development on sulfur oxides and nitrogen oxide control technology should be accelerated.* Sulfur oxides control technology for large coal- and oil-fired powerplants should be demonstrated in actual operation so that the technology can be applied throughout the industry. Both government and industry share responsibilities for this. Studies of better combustion methods to reduce oxides of nitrogen are also needed.

5. *A more balanced research and development program is necessary to hasten the development of more efficient energy processes.* Although control technology for sulfur oxides will provide appreciable improvement for several decades, a longrun answer to this type of air pollution lies in better energy conversion processes which will emit less pollutants per unit of energy produced. Gasified coal, fluidized bed combustion, breeder reactors, and nuclear fusion all hold promise. Al-

though research for new nuclear power sources has already received significant support, greater attention must be given to these other processes. Even now, the Nation needs to use its fuel resources more effectively through development of a national energy policy. Such a policy would guide the use of natural gas, low-sulfur coal and oil, and other energy resources to assure their availability and minimize air pollution.

6. *Incentives to accelerate industry support for research and to stimulate corrective actions should be considered.* Specifically, incentives might encourage increased research by the electric power industry to develop better control methods and new types of power that are less polluting. Other incentives could encourage a shift to techniques which would reduce pollution from combustion processes.

7. *The President's legislative proposals for regulating fuel and fuel additives, taxing lead to be used in gasoline, and testing emission systems on the production line are critical for meeting motor vehicle emission standards and should be enacted.*

8. *Alternatives available to assure continued control of motor vehicle emissions under actual road conditions should be evaluated.* Some alternatives include warranty of system effectiveness by the manufacturer, incentives to States to check vehicle emissions as part of their automobile inspection procedures, and development of more foolproof emission control systems as a prerequisite for Federal certification.

9. *The development and widespread testing of an inexpensive and effective emission control system for installation on used cars should be accelerated. Consideration should be given to requiring its use on all automobiles or on vehicles in areas with severe pollution problems.*

10. *The program for development of an unconventional vehicle propulsion system (e.g., steam, gas turbine, or hybrid) should be accelerated to assure that the technology will be available if conventional propulsion systems are incapable of meeting increasingly stringent Federal standards.*

11. *Increased research should be conducted on the development of transportation systems that not only move people and goods efficiently but also help reduce both dependency on the private car and, with it, air pollution.* Although the principal goal of mass transit is more efficient transportation, it is also a method to reduce air pollution. It deserves more study as such. Also, more research is necessary on the placement of roadways and traffic flow patterns as a method of minimizing air pollution.

12. *More research should be conducted on the effects of air pollutants on man.* More knowledge is especially necessary about short- and long-term health impacts of air pollutants. The number of health effect studies should be increased and a thorough evaluation made of current epidemiological evidence.

13. *Federal, State, and local monitoring programs must be improved considerably.* There is need to develop inexpensive automated instruments to monitor air pollutants. More monitoring stations, especially in areas of rapid population growth and industrialization, are vital. And standard methods of measurement need improvement.

14. *Land use planning and control should be used by State, local, and regional agencies as a method of minimizing air pollution.* Large industries and power generating facilities should be located in places where their adverse effect on the air is minimal. There is a need for State or regional agencies to review proposed power plant sites to assure that a number of environmental values, including air pollution, are considered.

15. *The United States should work toward cooperative arrangements with other nations in limiting total amounts of air pollutants emitted into the atmosphere.* Air pollution is no longer solely a local, State, regional, or even national problem. It is ultimately an international problem and must be so recognized. As discussed in Chapter V, the addition of particulates and carbon dioxide in the atmosphere could have dramatic and long-term effects on world climate. The United States should take the initiative in forming cooperative arrangements to control air pollutants that could have widespread effects.

POTENTIAL FOR PROGRESS

During the last 15 years, much data on the health dangers from air pollution have been accumulated. During that time, progress in improving air quality has not kept pace with increased population and urbanization—except in some cities where efficiency of combustion and changes in fuel use have reduced soot.

The costs and institutional barriers to higher air quality are not as massive as in water pollution control. Abatement technology can be installed rapidly when available. Clearly the technological gaps in air pollution control must be overcome, but once breakthroughs are made, rapid progress will be possible.

The Council on Environmental Quality believes that a very high priority should be given to air pollution control. The opportunities for making significant improvements in the environment, at relatively low cost, are impressive. Indeed, the benefits which can be derived from greater control of air pollution far outweigh the costs of the control measures.

V

Man's Inadvertent Modification of Weather and Climate

MAN MAY be changing his weather. And if he is, the day may come when he will either freeze by his own hand or drown. The delicate balances within the atmosphere and the history of climatic change in the past suggest that through his inadvertent actions he may be driving the atmosphere either to a disastrous ice age—or as bad—to a catastrophic melting of the ice caps. Either may literally be possible, but it depends on just what he is doing to the atmosphere. He does not know for sure.

Evidence continues to build that his activities and his growing populations alter the chemical composition of the earth's atmosphere and change its heat balance. And in turn these two alterations, in tandem, change weather and climate. But the processes and outcomes of such changes are largely unknown.

The science and technology of weather modification are only in their infancies. But they could grow overnight if man will increase his efforts to learn what he is inadvertently doing to his own atmosphere.

CLIMATIC CHANGES OF THE PAST

Geological and historical records clearly show that major climatic fluctuations have taken place down through history. Since the last advance of the ice sheet in Eurasia about 10,000 years ago, the permanent ice cover in the Northern Hemisphere has been limited largely to the Arctic Ocean, Greenland, and some high latitude islands.

But alternating periods of warming and cooling have occurred during the last 10,000 years. In the last century, instruments have been available to keep current records, and they show a pattern of climatic fluctuations.

Climate is much too complicated to be described by any single parameter. One useful guide is the average annual temperature at the earth's surface. Beginning in about 1890, this average temperature began an irregular climb. By 1940, it was 1.1° F. higher than it had been during the decade from 1880 to 1890. But in the 30 years from 1940 to 1970, the average temperature has fallen about 0.5° F. Thus, during the last three decades, one-half of the warming that occurred during the preceding six decades has been erased.

Associated with rising temperature in the Northern Hemisphere were movements of the frost and ice boundaries. Simultaneously, pronounced aridity gripped the south central parts of Eurasia and North America. This led to dust-bowl conditions in some areas and a northward displacement of the polar fronts. The recent lowering of the temperature has been accompanied by the shifting of frost and ice boundaries to the south and marked increases in rainfall in parts of previously arid continental regions. In the last two winters, ice coverage in the North Atlantic has been among the most extensive in over 60 years. Because of it, Icelandic fishermen suffered great losses, and the colder temperatures substantially diminished Iceland's agricultural output. In contrast, the rains in central continental regions, particularly in India and East Africa, contributed to high wheat yields. These experiences illustrate dramatically how sensitive the complex pattern of human activity is to relatively small shifts in climate. Man's ability to predict such changes is still very limited.

These fluctuations of only a few tenths of a degree observed over decades are small compared to the climatic variations of the "Little Ice Age" from 1650 to 1840, the warmer period between A.D. 800 and A.D. 1000, and the still larger variations of a few degrees associated with the few earlier ice ages and their retreats.

HOW MAN CAN CHANGE CLIMATE

The key question is: To what extent are climatic fluctuations of the past years due to natural processes or to man's intervention?

Man can change the average atmospheric temperature slightly and thus significantly affect climate in at least seven ways:

- He can increase the carbon dioxide content of the atmosphere by burning fossil fuels.
- He can decrease atmospheric transparency with aerosols (tiny solid or liquid particles floating in the air) from industry, automobiles, and home heating units.
- He can decrease atmospheric transparency by introducing dust (particles larger than aerosols), primarily through improper agricultural practices.
- He can alter the thermal properties of the stratosphere (upper atmosphere) with water from the combustion of jet fuels.
- He can heat the atmosphere by burning fossil and nuclear fuels.
- He can change the ability of the earth's surface to reflect sun radiation back into space through urbanization, agriculture, deforestation, and reservoirs.
- He can alter the rate of transfer of thermal energy and momentum between the oceans and atmosphere by spilling oil on the water's surface. Such oil films on the ocean come from incomplete combustion or spills from sources such as vessels and drilling towers.

Carbon Dioxide—An Earth Warmer?

The atmosphere's energy, which determines weather and climate, is derived primarily from visible solar radiation absorbed by the earth's surface and atmosphere. The absorption of that energy tends to raise the temperature at the surface. The earth's surface maintains its thermal balance (keeps from overheating) by radiating energy back to space at longer wavelengths. Carbon dioxide in the atmosphere absorbs incoming visible radiation, but in amounts too small to have any appreciable effect on the radiation reaching the lower atmosphere and the earth's surface. However, carbon dioxide is virtually opaque to some long-wave radiation that is emitted by the earth's surface. Thus, when carbon dioxide concentrations increase, heat loss through radiation from the surface is reduced—the "greenhouse" effect.

Attempts have been made to calculate carbon dioxide effects on the average surface temperature. One investigator calculated that atmospheric carbon dioxide content increased at a nearly constant rate from the 19th-century level of about 290 parts per million to 330 in the late 1950's. This increase—about 14 percent—could have caused the temperature rises observed with instruments during the first 40 years of this century.

Recent surprising findings indicate that as increasing fossil fuel consumption raises carbon dioxide output, a lesser percentage of it is retained by the atmosphere, and a larger portion is absorbed by the oceans. Scientists from Sweden and the Environmental Science Services Administration (ESSA) say that only about half the carbon dioxide produced by fossil fuels from 1958 to 1960 remained in the atmosphere. During the last 5 years, less than 40 percent of manmade carbon dioxide has stayed in the atmosphere. Other calculations also show that the effect of carbon dioxide on the temperature, as illustrated in the preceding paragraph, has been overestimated.

A detailed series of observations by Swedish, Scripps Institution of Oceanography, and ESSA scientists shows that from 1958 to 1970 the carbon dioxide concentration in the atmosphere increased from 312 to 320 parts per million—an average annual jump of 0.7 parts per million. This rate, if continued, would double manmade carbon dioxide accumulations in the atmosphere in about 23 years. Yet the bulk of carbon dioxide has entered the atmosphere at a time when the earth's surface temperature was falling rather than rising. Thus, the heating effects of carbon dioxide are apparently being counteracted by natural fluctuations or by other manmade activities.

Any attempt to extrapolate the future effect of carbon dioxide on climate must be uncertain because the fraction of carbon dioxide that will enter the ocean is unknown. If 60 percent of the emissions of carbon dioxide remains in the atmosphere and there is a 5 percent yearly growth of fossil fuel consumption, then by 1990 there would be about 400 parts per million in the atmosphere. If this were not offset by other activity, then the earth's average surface temperature would increase by 1.4° F. On the other hand, if 40 percent of the artificially produced carbon dioxide enters the atmosphere and the present 4 percent growth of fossil fuel consumption continues, then a level of 400 parts per million will not be reached until about the year 2010.

The maximum amount of carbon dioxide that man might introduce into the atmosphere can be determined by estimating the total available fossil fuels. One estimate puts the maximum available coal at about 7.6 thousand billion (7.6×10^{12}) metric tons. This is about twice the coal resources established by geological mapping. Estimates of petroleum resources vary considerably. Some researchers estimate that approximately 2 thousand billion (2×10^{12}) barrels of oil are ultimately recoverable, while others appear to favor the somewhat lower figure of 1.35 thousand billion (1.35×10^{12}). If these fossil fuels were burned, they would produce about 3.3 million trillion (3.3×10^{18}) grams of carbon dioxide. If one-half of that carbon dioxide were added to the atmosphere and there were no compensating effects, then the earth's average temperature would increase by about 2° to 3° F. Such a rise, if not counteracted by other effects, could in a period of a few decades, lead to the start of substantial melting of ice caps and flooding of coastal regions.

Particle Pollution—An Earth Cooler?

A human activity which may accelerate temperature drops—and thus help compensate for any carbon dioxide-generated temperature rise—is the injection of small particles into the atmosphere.

Certain kinds of industrial processes emit cloud condensation nuclei (small particles around which raindrops can form). This affects the frequency of fog and low cloud layers. These in turn influence the radiation that reaches the earth from the sun. Forest fires also produce cloud condensation nuclei (from dust and ashes) plus large quantities of heat and water vapor. Large-scale burning of forest refuse and accidental forest fires, which are particularly common in the Western States (but less prevalent than in the past), might modify climate and weather over large regions in this way. The net effect depends on the abundance, size, distribution, and altitude of the particles. Some investigators estimate that a decrease of atmospheric transparency of only 3 or 4 percent could lead to temperature reduction of 0.7° F. Another study shows that the addition of 1 percent in the world's average low cloud cover lowers temperatures by 1.4° F. This is almost three times the decrease measured in the last two decades. On the average, about 31 percent of the earth's surface is blanketed by low clouds. If this figure were to reach 36 percent, and there is no evidence at the present time that it will, the temperature would drop about 7° F. That would bring the earth's temperature very close to that required for a return of an ice age.

Increases of fog and low clouds when open country is turned into urban areas are well documented. But it is not known whether there has been any increase of global cloud cover. With satellites, data are now obtained fairly routinely of clouds above oceans. But data are often incomplete because high clouds prevent satellite observation of lower clouds.

One study, by J. Murray Mitchell, concludes that a major part of the variation is due to fine-grained particles introduced into the stratosphere (upper atmosphere) by volcanic eruptions. Mitchell's calculations are based on estimates of the total debris associated with volcanic explosions, an assignment of 1 percent of this total to stratospheric dust, and an assumption of a 14-month lifetime for the stratospheric dust. All these numbers can be questioned. But if they are correct, it would appear clear that dust from volcanoes overshadows that from urban and agricultural pollution.

Thus, there exists no proof that urban, industrial, and agricultural pollution is the principal cause of the recent cooling trend. But it is significant that the apparent changes of atmospheric transparency caused by volcanic dust may be sufficient to bring about cooling of the earth's atmosphere. If pollution were significantly responsible, then the world would face an important problem of manmade global climate modification. Atmospheric pollution has increased markedly, and at the present time there still are no acceptable means of impeding its growth on a global scale.

Vapor Trails—Do They Change the Weather?

Altering the water content of the high atmosphere can upset the earth's radiation balance. Water vapor, like carbon dioxide, can absorb outgoing infrared radiation. In solid form, as ice crystals, it can also block incoming solar radiation. A rise of the stratospheric water vapor content from 2 to 6 parts per million would increase the earth's average surface temperature about 0.9° F. Aircraft add water from combustion of jet fuel. Before 1958, essentially no jet fuel was consumed by domestic airlines in the United States. In 1970, jet fuel is being used by U.S. domestic airlines at a rate of 7 billion gallons a year. Below the stratosphere, water vapor dilutes quickly. And the amount added by airliners is small compared with water naturally present at these altitudes. But above the stratosphere, water vapor stays, on the average, for about 18 months because it mixes only slowly with the lower atmosphere. Most commercial jets fly below the stratosphere. But future supersonic jets will travel in the stratosphere at altitudes of 60,000 to 70,000 feet. Assuming that water vapor stays in the stratosphere for an average of 18 months, 500 supersonic transports operating 7 hours per day could increase the water vapor content of the stratosphere over a hemisphere by 0.2 parts per million if it were uniformly distributed.

These changes appear small. But they augment natural fluctuations. For reasons not yet understood, the water vapor content of the stratosphere rose from 2 parts per million in 1964 to about 3 parts per million in early 1970. Artificially produced water vapor can accelerate that natural growth trend. Further study is necessary to better determine the effects of supersonic jet transports in the stratosphere before they are mass produced.

There is also evidence that jets contribute to high clouds. Observations at Denver indicate that from 1950 to 1958, on the average about 8% of the sky was covered by high clouds when there were no lower cloud layers. From 1965 to 1969, about twice that portion of the sky was covered by high clouds. Similar observations have been recorded at Salt Lake City. Both cities are on heavily traveled air routes although there may be other contributing factors. The long-term climatic consequences of such high cloud cover increases are still unknown.

Man and the Thermal Budget

The mean annual difference between solar radiation absorbed by the earth and long-wave radiation reflected from earth into space is about 68 watts per square meter. Most of this net energy surplus is used for the evaporation of water, heating of the atmosphere, and other meteorological processes. A tiny part, less than 1 percent, is used in the photosynthesis of green plants. It is thus turned into a relatively stable form of chemical energy.

Man's activities add slightly to the earth's "thermal budget." Heat generated by industrial, residential, and automotive sources supplement solar radiation. Averaged over the earth's surface, at present man is producing only little more than one ten-thousandth of the net radiation gain of the atmosphere. This is much too little to influence climate on a large scale, but it certainly alters local climate of cities. And in the future, man's energy input into the atmosphere could increase to major importance.

Energy Output—Disappearing Ice Cap?

In a primitive society, energy utilization consists mostly of the food consumed by the individual. This corresponds to a power output of about 100 thermal watts per person. The world average—including primitive and technologically advanced regions—is somewhat more than 1000 thermal watts per person. In the highly industrialized United States, energy consumption is equivalent to 10,000 watts for each individual. If world population grows to 5 billion and if the worldwide average of energy use increases to 10,000 watts per person, manmade energy input into the atmosphere would reach almost one-hundredth that of the natural net radiation balance over land areas. If energy consumption continues to increase at the present rate of 4 percent per year, then in 200 years artificial energy input into the atmosphere would equal one-third of the natural radiation balance. This level would be reached in only 100 years with a 10 percent yearly increase. These numbers are highly significant because an increase of a few tenths of 1 percent in the radiation balance, if long sustained, would cause polar ice to disappear completely unless other natural or manmade changes compensated for the energy gain.

The combined effect of carbon dioxide pollution and heat pollution is strongly in the direction of warming the earth's atmosphere. Particle pollution tends to lower the earth's temperature. Which pollution effect will ultimately dominate? Will we indeed drown or will we freeze? Despite firm predictions by some ecologists, we do not know the answers. Careful monitoring and extended research are required if we are to manage our global climate wisely. These questions may become critical in the future.

Raising the Albedo

Researchers have calculated that a unit increase in the earth's albedo (reflective surface characteristics) will cause a decrease in average surface temperature of 1.8° F. Thus, manmade changes of the albedo at the earth's surface, if large enough, can cause substantial changes in climatic conditions. Densely builtup regions have a higher albedo than forests and cultivated soils. Deserts, some of which may stem from man's activities, have a much higher albedo than grass-covered fields.

Proliferation of urban areas and highway systems may increase the earth's average surface albedo. The net effect of the change on climate is not understood because changes in albedo are usually accompanied by alterations in the surface roughness of the earth. These alterations affect the rate at which the surface can exchange heat and momentum with the atmosphere by winds and other turbulent processes. These changes can also affect weather and climate.

Oil on the Water

Effects of oil films on the ocean surface are still poorly understood. With their vast stores of thermal energy, the oceans act as balance wheels to climate. The atmosphere exchanges energy with the ocean through radiation and mechanical processes. The strength of the mechanical interaction associated with air moving over a wave-roughened surface depends on the surface roughness of the water and the velocity and regularity of the wind. Very thin oil films can alter this interchange by reducing turbulence, evaporation, and the radiation emission of the surface.

But it is still unknown if oil pollution contributes significantly to climatic change.

The City—A Thermal Mountain

It has long been known that the climate of cities, which represent the most concentrated form of environmental modification by man, differs appreciably from the climate of adjacent rural areas. There is a growing body of literature showing that industrial activities are modifying atmospheric properties and in some cases may profoundly change the weather.

Cities on the average have a temperature 0.9° to 1.4° F. higher than the surrounding countryside. The effect is even more marked in the winter when the minimum temperature may be 2° to 3° F. higher than that of the surrounding areas. In addition to the difference in temperature, cities are frequently covered with clouds, and the frequency of fog in wintertime can be twice that of the suburbs. Accompanying the increased frequency of cloud cover is a higher total precipitation. Table 1 summarizes the climatic changes produced by cities.

TABLE 1.—*Climatic Changes Produced by Cities*

Parameter	*City as compared with rural surroundings*
Temperature:	
Annual mean	0.9° to 1.4° F. higher.
Winter minimum	2° to 3° F. higher.
Cloudiness:	
Clouds	5 to 10 percent more.
Fog, winter	100 percent more.
Fog, summer	30 percent more.
Dust particles	10 times more.
Wind speed:	
Annual mean	20 to 30 percent lower.
Extreme gusts	10 to 20 percent lower.
Precipitation	5 to 10 percent more.

Several factors make the city warmer than the country. Direct energy input from home heating units, industry, and air conditioning helps raise the annual mean temperature and minimum winter temperature. Buildings naturally shelter the city so that wind speeds are lower, and the turbulent transfer of energy from the city to moving weather systems may decline. The increased cloudiness over cities, together with the effect of buildings and pavements on the amount of solar heat retained, further accentuates the direct input into the atmosphere.

The increased rain and snowfall in cities are probably also caused by a variety of factors. The heat of the city in effect causes a "thermal mountain" in which the surrounding air is pushed up vertically over the city to colder levels, aiding the precipitation process. In addition, industry, home heating units, and automobiles all produce particulate materials. These small particles act as nuclei around which water vapor condenses to form drops. Or if the temperatures are cold enough, certain particles can act as nuclei for ice crystals. R. H. Frederick of ESSA supports the theory that particle pollution plays a role in precipitation. He decribes a systematic tendency for cold season precipitation at 22 urban Weather Bureau stations in the eastern United States to average several percent greater on weekdays than on weekends. If substantiated in further studies on other urban areas, this finding goes far in explaining the differences in rainfall between the cities and the country.

The most dramatic cases of the relation of industrial pollution and weather are found in regions where the pollutants are concentrated in valleys. The emission of water vapor condensation nuclei from the stack of a single wood pulp mill in Pennsylvania causes fog formation which sometimes fills a valley several miles wide and 20 miles long and spills into adjacent valleys. Peter Hobbs at the University of Washington has shown that certain Washington State pulp and paper mills are prolific sources of cloud condensation nuclei and that clouds often form downwind of the mills. Hobbs argues that regions of abundant artificial condensation nuclei show an annual precipitation in the last 20 years 30 percent greater than the previous 30 years, although part of this increase is probably due to a natural change in climate. Furthermore, University of Washington researchers have found ice nuclei more abundant by as much as an order of magnitude over urban Seattle than over stations removed from industrial activity. These observations, taken along with those of Frederick, clearly show the potential influence of man-introduced particulate matter on the weather in industrial regions.

CONCLUSIONS

Examination of how man can change climate on a large scale leads to these conclusions:

- The chemical composition of the earth's atmosphere has been altered by man in a measurable way. Some of these changes, which have been mostly inadvertent, have only recently been recognized.
- The magnitude of these atmospheric changes is enough to alter the earth's surface temperature slightly. Carbon dioxide added to the atmosphere from burning fuels is sufficient to lift the average temperature by several tenths of a degree Fahrenheit. Other factors, however, have caused world temperature to drop slightly in the last 30 years.
- These changes in the atmosphere cannot be regarded as local. Heat input escaping from a city into the atmosphere changes the climate of that city. The combined effects of many cities may eventually alter regional and global climates.
- Enough is known about the physical environment to establish the fact that inadvertent modification is occurring. But not enough is yet known to predict all the consequences of atmospheric changes confidently.
- Despite its importance, research on inadvertent climate modification has been neglected. Only about 1 percent of Federal Government research monies for weather modification go to programs investigating man's inadvertent modification.

WHAT NEEDS TO BE DONE

The following suggestions should be considered for dealing with long-term problems of climate alteration:

1. *Worldwide recognition should be given to the long-term significance of manmade atmospheric alterations.*

2. *Worldwide ground monitoring of turbidity, carbon dioxide content, and water vapor distribution in the atmosphere should be done with particular attention to oceanic areas.* Ground-based observations should be supplemented by airborne monitoring of the number, density, size, and composition of particulate matter in the atmosphere. Such programs are an essential first step to establish pollution baselines.

3. *Satellite monitoring of global cloud cover, atmospheric heat balance, and surface albedo should be accelerated.* Particular attention should center on effects of altering the thermal balance through changes in albedo, carbon dioxide, and particulate matter.

4. *Research on models of the thermal and dynamical processes within the atmosphere and the boundary between the atmosphere and the solid earth and oceans need emphasis.*

VI

Solid Wastes

Solid wastes etch a trail of visible blight that leaves few corners of the country unspotted. Across the Nation the same scenes repeat—refuse in the streets, litter on beaches and along roadsides, abandoned autos on isolated curbsides and in weeded vacant lots, rusty refrigerators and stoves in backyards, thousands of dumps scarring the landscape. And the less visible aspects of the problem—solid wastes in the ocean, contamination of ground water, and wasted resources—are just as critical. America's well-known penchant for convenience has come face-to-face with major environmental problems.

Proper management of solid wastes is a key to upgrading environmental quality. Stricter enforcement of air quality standards has focused attention on burning dumps and inefficient incinerators, many of them operated by municipal governments. Water quality research is beginning to probe the effects of dumps and landfills on the purity of ground water.

Public appreciation of the magnitude of the economic and social costs of solid waste is building and a concept of solid waste management is evolving. It assumes that man can devise a social-technological system that will wisely control the quantity and characteristics of wastes, efficiently collect those that must be removed, creatively recycle those that can be reused, and properly dispose of those that have no further use.

The growing technology and affluence of American society have laid a heavy burden on solid waste facilities. Refuse collected in urban areas of the Nation has increased from 2.75 pounds per person per day in 1920 to 5 pounds in 1970. It is expected to reach 8 pounds by 1980. This spiraling volume of solid waste has a changing character. The trend toward packaged goods in disposable containers has put more paper, plastics, glass, and metals instead of organic matter into the refuse. And technology of solid waste collection and disposal has not kept pace with this change.

There has been little attempt to tie the production of consumer goods together with the disposability of those parts that end as waste. Disposal costs are not included in the price paid by the consumer; rather they are borne by society in general. With few exceptions manufacturers do not accept responsibility for the costs of getting rid of products that have been sold and served their purpose.

Solid waste collection in most municipalities is inadequate and antiquated, partly because over the years it has endured more than its share of public neglect. Refuse collection jobs are low status and low paying, and injury statistics show that only logging is a more hazardous occupation. Sanitation workers have been striking with increasing frequency, and heaps of reeking wastes have been left for days on curbsides in our largest cities. This has dramatized the human factors in the business of refuse collection. It has pointed up the close correlation between the working conditions of trash collectors and the public health menace of inadequate collection and disposal.

Disposal facilities are equally inadequate and antiquated. The Bureau of Solid Waste Management of the Department of Health, Education, and Welfare estimates that 94 percent of existing land disposal operations and 75 percent of incinerator facilities are substandard.

WHAT MAKES SOLID WASTES

The total solid wastes produced in the United States in 1969 reached 4.3 billion tons as shown in the following table:

	Million tons
Residential, Commercial and Institutional wastes	250
Collected	(190)
Uncollected	(60)
Industrial wastes	110
Mineral wastes	1,700
Agricultural wastes	2,280
Total	4,340

Sources: Bureau of Solid Waste Management, Department of Health, Education, and Welfare; Division of Solid Wastes, Bureau of Mines, Department of the Interior.

Most of it originated from agriculture and livestock. Other large amounts arose from mining and industrial processes. A little under 6 percent, or 250 million tons, was classified as residential, commercial, and institutional solid wastes. And only three-fourths of this was collected.

Although wastes from homes, businesses, and institutions make up a small part of the total load of solid waste produced, they are the most offensive and the most dangerous to health when they accumulate near where people live. Agricultural and mineral wastes, although much greater in volume, are generally spread more widely over the land. They are more isolated from population concentrations and may not require special collection and disposal. Nevertheless, as more is learned about the effects of agricultural and mineral wastes on the quality of air, water, and esthetics, steps to curb their production and facilitate disposal seem likely.

The largest single source of solid wastes in this country is agriculture. It accounts for over half the total. The more than 2 billion tons of *agricultural wastes* produced each year includes animal and slaughterhouse wastes, useless residues from crop harvesting, vineyard and orchard prunings, and greenhouse wastes.

Herds of cattle and other animals, once left to graze over large open meadows, are now often confined to feedlots where they fatten more rapidly for market. On these feedlots, they generate enormous and concentrated quantities of manure that cannot readily and safely be assimilated by the soil. Manure permeates the earth and invades waterbodies, contributing to fish kills, eutrophied lakes, off-flavored drinking waters, and contaminated aquifers. Feedlots intensify odors, dusts, and the wholesale production of flies and other noxious insects. Animal waste disposal is a growing problem because the demand for animal manure as a soil conditioner is declining. Easier handling, among other advantages, favors chemical fertilizers.

About 110 million tons of *industrial solid wastes* (excluding mineral solid wastes) are generated every year. More than 15 million tons of it are scrap metal, and 30 million tons are paper and paper product wastes; a miscellaneous bag of slags, waste plastics, bales of rags, and drums of assorted products discarded for various reasons make up the rest. The electric utility industry produced over 30 million tons of fly ash in 1969 from burning bituminous coal and lignite. By 1980, the figure could rise to 40 million tons. Currently, only about 20 percent of ash material finds any use.

In the past year, 1,700 million tons of *mineral solid wastes*, comprising 39 percent of total solid wastes, were generated in the United States—most of it from the mineral and fossil fuel mining, milling, and processing industries. Slag heaps, culm piles, and mill tailings accumulate near extraction or processing operations. Eighty mineral industries generate solid waste, but only eight of them are responsible for 80 percent of the total. Copper contributes the largest waste tonnage, followed by iron and steel, bituminous coal, phosphate rock, lead, zinc, alumina, and anthracite. By 1980, the Nation's mineral industries will be generating at least 2 billion tons of waste every year.

In 1969, Americans threw away more than 250 million tons of *residential, commercial, and institutional solid wastes*. Approximately 190 million tons were collected by public agencies and private refuse firms. The remainder was abandoned, dumped, disposed of at the point of origin, or hauled away by the producer to a disposal site. About $3.5 billion was spent last year handling the 190 million tons of collected solid wastes—an average of $18 per ton. Collection accounts for 80 percent of the cost ($14 per ton), disposal for the rest. A considerably higher rate of spending would be needed to upgrade existing systems to acceptable levels of operation.

The solid waste collected annually includes 30 million tons of paper and paper products; 4 million tons of plastics; 100 million tires; 30 billion bottles; 60 billion cans; millions of tons of demolition debris, grass and tree trimmings, food wastes, and sewage sludge; and millions of discarded automobiles and major appliances.

COLLECTION AND DISPOSAL

Residential, commercial, institutional, and industrial solid wastes are the clearest threats to health and to the environment. So they are the chief target of the waste disposal strategy. Most such waste comes from the urban areas and requires quick removal. It is increasing at a rate of about 4 percent a year.

Three facets of the production and discard of these growing mountains of solid waste materials need examination: solid waste handling, natural resource depletion, and litter and abandonment. Collection and disposal costs continue to spiral. This is partly because of wage hikes—to bring the pay of sanitation workers more into line with other occupations. But even more, it is to pay for new collection equipment and landfill and dumping sites and, in some communities, to amortize incineration equipment. Researchers are beginning to examine what is entering the solid waste stream. Ultimately they hope to reduce unnecessary discard or even to restrict the manufacture of some items.

Natural resource management requires that minerals in shortest supply be identified and efforts made to cut the quantity discarded and to recycle whatever is collected. Some key minerals are already recycled to a considerable extent. More lead is pulled from scrap than from mined ores, and nearly half of the copper used today comes from scrap. However, for many natural resources, substantial Federal income tax incentives and other laws and policies encourage use of the virgin material instead and undercut the competitive position of recycled materials.

The litter problem—tires, bottles, cans, plastics, and paper thrown away randomly instead of into waste containers—adds daily to collection costs and blight. Many of the nation's roads, beaches, rivers, parks, and other public areas are cluttered with the refuse of thoughtless citizens. Litter collection costs average $88 per ton, more than four times as much as collecting residential refuse.

Collection Methods

Refuse collection methods in most of the United States do not differ substantially from what they were when workers picked up the trash in horse-drawn wagons before the turn of the century. This lack of technological advance is particularly burdensome because up to 80 percent of the funds spent on solid waste management goes into collecting the waste and hauling it to a processing plant or a dump.

The one significant advance has been the compactor truck. These closed-body vehicles now make up a large part of the 150,000 refuse collection trucks in the United States. With hydraulic presses, they compress waste, usually at a 3-to-1 ratio, thus saving vehicle space and cutting the number of trips necessary to cover collection routes. However, the compactor has disadvantages. Because refuse of different types is mixed and crushed, recyclables are lost or contaminated by unusable waste. It is also hazardous to operators.

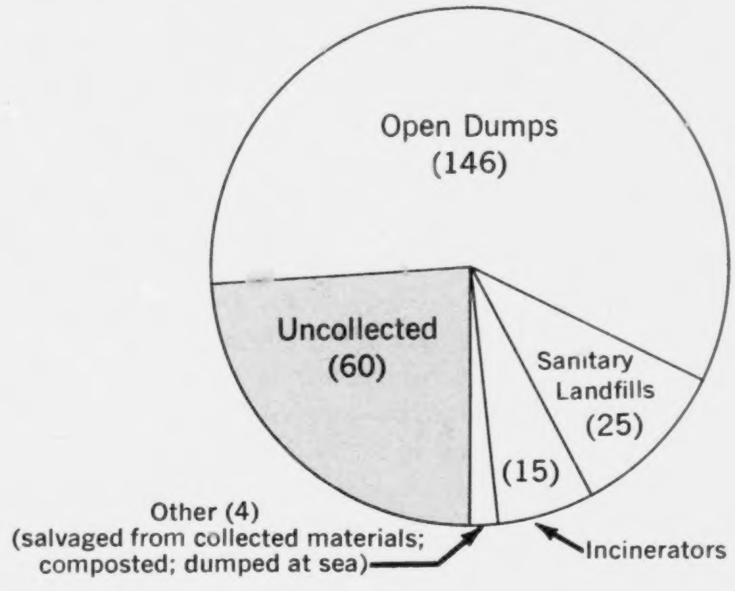
Efforts are underway to modernize trash collection. Under one Federal grant, researchers at The Johns Hopkins University are studying the practicability of transfer points in waste collection systems serving large cities. Under another, the University of Pennsylvania is studying the possibility of pipelines for collecting and removing domestic solid wastes. The pipeline method may be technologically feasible and economically attractive. But these are just beginnings. More research is mandatory.

Disposal Techniques

The final disposal point for an estimated 77 percent of all collected solid wastes is 14,000 open dumps in the country. Thirteen percent is deposited into properly operated sanitary landfills, where wastes are adequately covered each day with earth of the proper type. Nearly all of the remaining 10 percent is burned. Incinerators are used primarily in large cities, where the volume of refuse and the high cost of land make incineration an attractive disposal method. Small quantities of solid wastes are turned into nutrient-rich soil conditioners by composting operations. And a small but troublesome percentage is dumped at sea.

Land disposal of solid wastes can range from the most offensive fly- and rat-infested open dump to technically advanced practices that end in the creation of parklands, golf courses, outdoor theaters, and other public facilities. Disposal sites in or near urban areas can be reclaimed for use as attractive open space if proper sanitary landfill practices are employed.

Imaginative thinking in land disposal practices is not widespread. Collected refuse is dumped in whatever area is available, with little or no provision for soil cover. Often city fathers blame spontaneous combustion for fires at these dumps. But in at least some cases, local sanitation officials set fire to wastes to reduce their volume because dumps are overloaded. Burning at open dumps remains a major cause


Disposal of Residential, Commercial, and Institutional Solid Wastes, 1969

Million tons, estimated

Total—250 million tons

Source: Bureau of Solid Waste Management, HEW.

of air pollution in some cities. Improper landfill techniques can spawn large quantities of methane gas and breed armies of rats, flies, and other pests. Disposal sites often mar wetlands and scenic areas. Some are uneconomical because of their distance from the city. In California, filling canyons and other natural areas has been censored by conservation groups.

Improved equipment for landfilling is being developed. For example, with a grant from the Bureau of Solid Waste Management, King County (Seattle), Wash., is constructing a machine called the "Mole," which will compact refuse at high pressure and dispose of it below ground level. Under another grant, a landfill operation near Virginia Beach, Va., will be turned into a huge manmade hill for an amphitheater. A similar site near Chicago will be developed for tobogganing and skiing.

The city of Madison, Wis., has a grant to build and operate a hammer reduction mill to test the economic feasibility of salvaging paper and metals. Preliminary investigations of salvage possibilities are inconclusive, but disposal aspects of the mill look promising. It may be possible, for example, that milled refuse may safely be deposited in a landfill without earth cover.

Strip mining for coal has scarred some landscapes in the United States and left them denuded of vegetation and open to erosion. Several years ago rail haul of solid wastes was proposed as a solution to two environmental problems—unsightly abandoned strip mines and the shortage of disposal sites near large eastern cities. The plan involved using railroad dump cars which usually return from cities to mining sites empty. Many factors, including outlying community resistance to taking in other people's refuse have limited that idea. But disposal costs in large cities have shot up so sharply that the concept is being reconsidered. A Federal grant has been awarded to the American Public Works Association to investigate hauling refuse by rail from large urban areas to remote, mined areas for landfilling.

Nearly 10 percent of domestic solid wastes is processed through *incineration*; 300 municipal incinerators account for about half the tonnage burned; the rest is consumed in thousands of small, privately owned trash burners. After incineration, about 25 percent of the waste by weight remains—as ashes, glass, metals, and unburned combustibles. These then must be removed and recycled, or disposed of in some way.

Since municipal incineration is often cited as a polluter of air, research is underway to improve incinerator technology. A German process involves a mechanically stoked rotary drum incinerator designed for small communities. West Virginia University is studying a fluidized-bed incinerator fueled by mixtures of domestic and industrial solid wastes.

One of the most promising engineering concepts in solid waste management is the CPU–400, now under development by the Combustion Power Co. of Palo Alto, Calif. The CPU–400 is a fluidized-bed incinerator, which burns solid waste at high pressure, which produces hot gases, which power a turbine, which in turn drives an electric generator. Municipal solid wastes constitute a better fuel than might have been expected. They have a heating value of 5,000 British thermal units per pound—about one-third that of a good grade of coal. Municipal wastes are also low in sulfur, a major air pollution source. As designed, the CPU–400 should produce approximately 15,000 kilowatts of electric power daily, while burning 400 tons of municipal refuse. The generator unit should supply 10 percent of the electric power requirements of the community providing the refuse. Up to three-fourths of the heat in the gas turbine cycle is available for auxiliary functions such as steam production, sewage sludge drying, or perhaps saline water conversion. The CPU–400 concept also envisions using the vacuum produced by the gas turbine to draw refuse to the incinerator from collection points in the city—through pipes buried in the streets.

The Bureau of Mines of the Department of the Interior is applying the process of carbonization (destructive distillation) to the disposal of industrial wastes and urban refuse. This process involves the thermal conversion of materials into usable forms of solid, liquid, and gaseous products.

An insignificant amount of collected solid wastes in the United States is *composted.* Metals, glass, and similar inorganics are sorted from mixed refuse, and the remainder is converted to a peat-like organic fertilizer and soil conditioner. This process is widely used in Europe. Madrid composts 200 tons daily and Moscow is opening a new 600-ton-per-day facility. Composting has never been popular in the United States for several reasons. Compared to many Western European nations, land available for disposal sites in the United States is inexpensive. The compost product has not always been of uniform quality here; nor has it competed with commercial soil conditioners. Also, the composition of refuse in the United States makes it more difficult to compost, since its organic content is low. Finally, composting was first sold to American cities as a profitmaking venture. When it did not pay off, many cities considered the enterprise a failure. The Bureau of Solid Waste Management, jointly with the Tennessee Valley Authority, is operating an experimental composting plant in Johnson City, Tenn. But the results have not been encouraging. In recent years almost all composting plants in this country have shut down.

Some coastal cities and industries are turning to *ocean disposal* to get rid of solid waste. Lack of suitable land disposal sites and stricter air pollution standards for incinerators make ocean dumping look attractive. In his April 15 Message on Waste Disposal, the President directed the Council on Environmental Quality to report to him by September 1, 1970, on environmental problems associated with ocean dumping.

RECYCLING AND REUSE

In his February 10 Message on the Environment, the President announced the Federal Government's goal to reduce solid waste volume and encourage reuse and recycling. Recycling waste materials into the economy has not been widely applied in the United States. Economic considerations and the abundance of virgin resources have forestalled the development of recycling technology and markets. Primary materials producers, often with the help of tax concessions, have developed remarkably efficient technologies for removing metals and other substances from their virgin state. But meanwhile, techniques for separating and recovering waste materials remain primitive and expensive.

There are many aspects to recycling. The characteristics and the volume of the products which enter the market and eventually end up as solid wastes are one. Identification of characteristics and items most troublesome to solid waste management is another. And decisions on how to control their presence in refuse are still another. Some items can be returned by consumers for reuse. Others may be sorted by householders for separate collection. Or the most economical solution may be to salvage from mixed collection wastes.

Sorting Mixed Refuse

Much more work is needed to develop an effective way to salvage the valuable elements of collected mixed refuse. It is difficult and costly. And the instability of salvage markets has only added to the problem. The Stanford Research Institute in Menlo Park, Calif., has constructed a pilot scale unit in which a vertical stream of air separates mixed waste materials. After technical difficulties are overcome, this air classification process may prove an economic alternative to hand separation.

At College Park, Md., the Bureau of Mines has constructed an advanced reclamation system with mechanical separators which sort metals and glass from incinerator residues. Recent technological advances there have produced a highly sophisticated process which sorts glass by color and isolates several exotic metals. It adds $3 per ton to normal collection and disposal costs, not considering any income from the sale of salvaged materials. The Bureau is now developing data for the design of commercial plants based on this process.

Auto Disposal

A number of specific components in solid wastes present particular problems and require special mention. Abandoned autos are one of the most conspicuous solid waste disposal problems. On the average, 9 million autos are retired from service every year. Although statistics on the annual number of abandoned vehicles are subject to dispute, it is thought that approximately 15 percent are abandoned on city streets, in back alleys, along rural roads, and in vacant lots throughout the Nation. Most autos are abandoned because they are no longer serviceable and have little or no parts value to auto wreckers. The total number of abandoned cars in the country is even harder to ascertain, but has been estimated between 2.5 and 4.5 million.

The 85 percent of autos that are properly turned in by their owners enter a complex recycling system, usually beginning with the auto wrecker, whose chief business is selling the parts that can be removed. Some wreckers claim to obtain 97 percent of their sales revenues from parts. The high value of junk cars for parts and their often negligible value for scrap means that wreckers have little incentive to move their inventories to scrap processors. Except when there is demand for scrap, the junk cars just pile up.

Auto wreckers eventually, however, have to move the hulks to scrap processors. Most processors, using powerful hydraulic presses, reduce the cars to small bales containing high percentages of nonferrous materials—copper, upholstery, chrome, plastic, and glass. The bales are then sold to steel mills, which turn them into products which do not require high quality steel, or pass them on to mills which have sufficient capacity to dilute their contaminants. A growing number of processors produce a higher priced scrap through mechanical shredding and electromagnetic separation. Costs for shredding equipment, however, have limited the widespread use of this process, particularly by small scrap processors.

Steel mills and foundries are major users of ferrous scrap. In 1969, 50 percent of the material used for the production of all steel products was scrap. Six percent of that scrap was from junk autos. But changes in steel production techniques make it difficult to predict future scrap needs. Basic oxygen furnaces and electrical induction furnaces are partially replacing the open hearth furnace. The first requires less scrap, but the second uses more. It is even more difficult to predict export scrap demand and the effects of new fabricating and casting processes on the scrap market.

In his February 10 Message on the Environment, the President asked the Council on Environmental Quality to take the lead in recommending a bounty payment or some other system to promote the prompt scrapping of all junk automobiles. The Council has reviewed the range of alternatives leading to a Federal or State bounty system and concluded that under present conditions it is not practicable.

Most of the systems considered by the Council would be funded by a tax on the sale of all automobiles sold in the future or the collection of a fee from all present owners and future buyers. The bounty payment would be made to the scrap processor, the auto wrecker, or the owner of the car being junked. All of these proposals would put an unfair burden on the owners of the 85 percent of autos that are properly turned over to auto wreckers, in order to take care of the remainder which are not. Furthermore, the Council is not persuaded that the demand for auto scrap would be improved by such a system, nor that it would in fact influence the economics affecting abandonment. The resulting fund of payments would divert billions of dollars from other investments in the private economy. Administration and enforcement of the system would require excessive increases in government personnel and expenditures. The Council also determined that firm penalties against abandonment and improvement of State title and transfer laws alone, particularly for cars of low value, might substantially reduce abandonment and put abandoned vehicles more promptly into the scrapping cycle. Such laws should be strengthened.

Any attempt to solve the problem of abandoned cars, however, must consider the problems of fluctuating scrap demand, steel production technology, transportation rates for scrap, export scrap markets, availability of shredding equipment, and characteristics of the auto parts market. Otherwise, assuming abandonment could be reversed, hulks would only continue to pile up in junk yards. The Council will continue its study of these broader problems, looking toward a solution that will involve the entire auto scrapping system.

Other Items

In 1969, 43.8 billion *beverage containers* for beer and soft drinks were made in the United States. If the trend to throw-away containers continues, by 1980, 100 billion of these bottles and cans will be produced and discarded every year. Beverage containers already comprise 3.9 percent of all collected refuse, and the number is growing at a rate of nearly 7.5 percent per year—compared to 4 percent for all refuse. Bottles and cans constitute a major part of what is left in incinerators after burning. They must be hauled to land disposal sites. Each year an estimated 1 to 2 billion glass and metal beverage containers end up as litter on highways, beaches, parks, and other public areas. Severe penalties for littering have not worked in the face of the rising sales of the throw-away bottle and can, and strict enforcement of these laws has been difficult.

Paper constitutes almost 60 percent of roadside litter and is difficult to collect. Last year, 58.3 million tons of paper were consumed in the United States. Nineteen percent of this was recycled. Fifteen percent was temporarily retained or lost its identity in manufacturing processes. The remaining two-thirds—or 40 million tons—was discarded as residential, commercial, institutional, and industrial solid wastes. Typically, paper comprising 40 to 50 percent of mixed refuse is disposed of at an annual cost of over $900 million. Paper production is a multiple polluter. It crops up as a factor in timber wastes, in air and water pollution, and in the removal of organic materials from soils in managed forests. Much of the discarded paper consists of technically reusable fiber. Although the United States recycles only 19 percent of its paper, Japan reclaims and reprocesses nearly half of the paper its people use.

Plastics comprise an increasingly worrisome element in solid wastes. They are virtually indestructible, do not degrade naturally, and resist the compression plates of compactor trucks. In incinerators most plastics tend to melt rather than burn and to foul the grates. One range of plastics, polyvinyl chloride (PVC), is a new arrival in the packaging market. When burned, it produces hydrochloric acid. Although not yet widely used in the United States, in Germany it has already been blamed for increased air pollution, damage to incinerator stacks, and—in rare cases—destruction of nearby flora.

Another potential problem arises from disposing of *pesticides*. As stronger legislation and regulation of these agents take effect, the proper disposal of undesirable or condemned commodities becomes important. Even the containers used to market pesticides may retain considerable toxicity after discard. Although there have as yet been no serious cases, concentration of these agents in sanitary landfills and open dumps could contaminate ground water and imperil public health.

Rubber tires are just as difficult to get rid of. Burning them pollutes the air. In sanitary landfills, they defy compaction and tend to gravitate to the surface. Changing technology has lessened the use of old rubber in the manufacture of new rubber products; thus most old tires are not recycled.

The Fish and Wildlife Service and the Bureau of Solid Waste Management are investigating the use of old tires as reefs and fish havens along the Atlantic coast of the United States. The ocean bottom is sandy and relatively flat for great distances. And artificial reefs constructed of tires may promote an increase in desirable species since many game fish require relief features such as reefs for protection and spawning grounds. If this concept proves practical, very large numbers of old tires could be turned into an important ecological side benefit.

THE FEDERAL ROLE

Local governments have traditionally shouldered primary responsibility for solid waste collection, processing, and disposal. Not until 1965, with passage of the Solid Waste Disposal Act (Public Law 89–272), did the Federal Government assume a major role. Under the act, the Federal Government is responsible for research, training, demonstrations of new technology, technical assistance, and grants for State and interstate solid waste planning programs. The legislation focuses attention on studies to conserve natural resources by reducing waste and unsalvageable materials and by solid waste recovery. Under the act, the Department of the Interior, through the Bureau of Mines, received expanded authority to examine problems of mineral, metal, and fossil fuel wastes. The Department of Health, Education, and Welfare, through the Bureau of Solid Waste Management, administers the Federal program for solid wastes from all other sources.

Research and Development

The Bureau of Solid Waste Management and the Bureau of Mines have been instrumental in developing several of the technological innovations so far. Local governments have only limited funds, and municipal officials are timorous about interfering with refuse collection routines for fear of upsetting labor relations and public relations.

Consequently, local innovation has been minimal. Even when the evidence is clear that new methods result in improvements, jealousies and fear of adverse employee relations sometimes prevent implementation. Most State governments have also avoided heavy research and experimental program funding in solid waste management. This emphasizes the need to design Federal research and development programs to assure that once the value of an innovation is evident, it is quickly incorporated into as many systems as possible.

Recycling

The role of government in recycling solid wastes has many uniquely Federal facets. Successful return of waste to some point in the production process is closely tied to the volume and characteristics of manufactured goods. Except for a few large States and a few specific products, it is difficult for State governments to influence these factors significantly. It is virtually impossible for local governments to do so.

The Federal Government is heavily committed to the emerging technology of salvage and recycling. When salvage is technically feasible but economically unprofitable, the Federal Government should evaluate the use of incentives to encourage recycling rather than production from virgin resources. Federal research into mixed refuse sorting and salvage has advanced, and some innovations are nearly ready for widespread application.

Regional Cooperation

Unlike air and water pollution, which can befoul even distant areas, solid wastes harm only the immediate surrounding area. Thus, solid waste mismanagement primarily affects the area where wastes are dumped and secondarily the community from which they are collected. When improper solid waste disposal practices such as burning and poorly controlled sanitary fill operations foul their air or water, areas outside the locality can invoke air and water quality enforcement laws. Where the land resources of other local jurisdictions are used for dumping or incineration, the community can levy a charge to offset the cost of degrading the environment.

Local residents are becoming more aware that municipal solid waste disposal systems are deficient. Communities are modernizing, and in many places citizens have campaigned successfully for new disposal facilities. Federal grants are not always desirable, since they penalize taxpayers in communities that have the foresight to handle their problems and force them to pay a share of the cost of facilities for communities that do not.

There is, however, one area open to State and Federal help—intermunicipal cooperation. Metropolitan areas, many local jurisdictions, and particularly the central cities face severe disposal problems which are not entirely resolvable at the local level. Disposal sites are hard to find and to buy as land costs spiral and as citizens urge the preservation of nearly every remaining nearby natural area. The cost of municipal incineration with proper air pollution controls is too high for many small jurisdictions within the metropolitan area.

Regional solid waste management is evolving as the only rational approach in many urban areas, even though local officials often balk at turning over control of any aspect of solid waste management to a metropolitan-wide authority. Consolidation jeopardizes vested interests. Patronage, position, and status of individual employees and the degree of control over solid waste management within the community's own boundaries (including location of disposal sites) militate against intermunicipal cooperation. To mitigate these factors, higher levels of government must devise ways to encourage coordination on a regional basis.

WHAT NEEDS TO BE DONE

The Council on Environmental Quality recommends the following:

1. *The programs for research and demonstration projects in the Bureau of Solid Waste Management and the Bureau of Mines should be focused on:*
   - *Collection procedures*—More research is needed to develop new collection methods. Eighty percent of the cost of solid waste management is devoted to collection; yet technological change has been slowest in this area.
   - *Household sorting*—This should be encouraged. Reliable studies are necessary to determine if greater sorting of solid wastes by households makes economic and social sense. New technologies should be devised to make economical and acceptable to housewives a wider range of sorting techniques. Collection methods for sorted materials must also be developed.
   - *Sorting from mixed refuse*—Far greater creative efforts are needed to develop a technology for sorting mixed refuse to

salvage valuable items. The Bureau of Mines has made significant progress in recovery from incinerator residues, but there is still no effective way to salvage from the 90 percent of collected refuse that is destined for dumps or sanitary landfills.

- *Litter*—Ways must be found to remove paper, metal, and glass items mechanically from the Nation's highways, beaches, and other public areas.
- *Recycling*—Methods must be developed to reuse a greater percentage of products and to develop new products from and new uses for solid waste.

2. *Available Federal funding should be directed to selective, large-scale demonstrations of innovations in solid waste management in one or more major metropolitan areas.* One of the major difficulties in changing solid waste management is the reluctance of authorities in major urban areas to commit themselves to significant spending for innovations that have been tested only in small towns or under controlled conditions. Federal support could assist in providing a smooth transition from research to large-scale demonstration projects.

3. *Maximum recycling and reuse of materials are necessary to reduce the growing volume of solid wastes that must be disposed of.* The Council is working with a number of Federal agencies to develop a recycle strategy and is studying a variety of special disposal problems. Industry, private research organizations, and all levels of government must be enlisted to maximize the recycling of solid wastes.

VII

Noise, Pesticides, and Radiation

As pollutants of the environment, noise, pesticides, and radiation are relative newcomers to the public ken. The three are still shadowy and dimly understood. But they are here, and they must be dealt with.

Noise has been defined as "sound without value," and the intensity, variety, and clamor of unwanted, unvalued sounds have multiplied in recent times. For many, city residents in particular, the din never ceases, and it too rarely diminishes.

Pesticides, created as tools to help forge a better life for man, have turned against him in many ways and have become killers of animal and plant life that they were never intended to harm. We do not fully understand their impact on man and the environment, but we know enough to find them disturbing.

Radiation is potentially a more dangerous pollutant to man than pesticides. Man has tried to turn it to his peaceful benefit—and has done so in several ways. But the effects of low levels of radiation are still largely unknown.

The long-term and cumulative impacts of this triumvirate of pollutants—noise, pesticides, and radiation—could be harmful to man. It is therefore imperative that they and their ways become better known.

NOISE

Noise is everywhere, especially in urban areas, where three-fourths of the Nation lives. The roar of air and surface transportation, the general din and hum of construction projects, and industrial noise all pound against the ear virtually without ceasing. In the decade of the 1960's, the measured amounts and extent of urban noise rose significantly. And so did the social awareness of noise and the discomfort caused by it.

Urban dwellers cannot escape it. They are surrounded by a multitude of noise sources in homes, offices, or places of work. Even at play they are bombarded by scores of outdoor noises.

The most severe noise conditions are generally encountered in the work environment. Excessive exposure to such noise for long periods is known to cause irreversible hearing loss. It is estimated that up to 16 million American workers today are threatened with hearing damage.

The worker exposed to noise during the working hours must also endure high levels of noise on his way to and from work. Furthermore at home he must listen to household appliances, noisy neighbors, and a variety of outdoor noises which surround and permeate his dwelling.

Sources of Noise Pollution

Traffic noise in a modern city may reach 90 decibels. A decibel is a logarithmic measure of sound. Because it is logarithmic, linear comparisons of decibel levels cannot be made. For example, a noise pressure level of 130 decibels is 10 times as great as one of 120 decibels and 100 times as great as a noise pressure level of 110 decibels. It is widely accepted that steady exposure to about 90 decibels can cause permanent hearing loss.

In general, trucks, buses, motorcycles, and rail systems are the worst offenders. With automotive vehicles at high speeds most of the noise comes from the whir of tires, while at lower speeds motor noise dominates. At expressway speeds a single trailer truck can generate steady noise levels above 90 decibels. A line of trucks can produce noise levels of 100 decibels or more.

The high noise level inherent in steel wheels rolling on steel rails makes rapid rail systems noisy. Subways create noise even on the streets when they cause buildings to vibrate or when the noise escapes through ventilators, but most of the noise is absorbed by the ground.

Weighted Sound Levels and Human Response

Sound Source	dB (A)*	Response Criteria
	150	
Carrier Deck Jet Operation	140	
		Painfully Loud
	130	Limit Amplified Speech
Jet Takeoff (200 feet)	120	
Discotheque		
Auto Horn (3 feet)		Maximum Vocal Effort
Riveting Machine	110	
Jet Takeoff (2000 feet)		
Shout (0.5 feet)	100	
N.Y. Subway Station		Very Annoying
Heavy Truck (50 feet)	90	Hearing Damage (8 hours)
Pneumatic Drill (50 feet)		
	80	Annoying
Freight Train (50 feet)		
Freeway Traffic (50 feet)	70	Telephone Use Difficult
		Intrusive
Air Conditioning Unit (20 feet)	60	
Light Auto Traffic (50 feet)		
	50	Quiet
Living room		
Bedroom	40	
Library		
Soft Whisper (15 feet)	30	Very Quiet
Broadcasting Studio	20	
	10	Just Audible
	0	Threshold of Hearing

*Typical A—Weighted sound levels taken with a sound-level meter and expressed as decibels on the scale. The "A" scale approximates the frequency response of the human ear.

Source: Department of Transportation.

Sound bouncing off the walls can raise subway noise levels to 90 to 100 decibels in the cars.

The rapid growth of aviation since World War II and the development of jets have created a major noise problem in airports and the areas around them. A four-engine jet at takeoff generates 115 to 120 decibels. A measure of the resulting annoyance is that about 50 of the 140 major American airports are involved with formal complaints concerning noise, including a sizable number of lawsuits. The Airport Operators Council International estimates that by 1975, 15 million people will be living near enough to airports to be subjected to intense aircraft noise.

Cities suffer from a variety of other noise sources which are rarely curbed by government. Compressors and jackhammers are major offenders. Garbage trucks, lawnmowers, and rock-and-roll music blasting out of discotheques and jukeboxes all add to the din.

At home, the kitchen with its various appliances is the noisiest room. The lack of effective noise standards in building codes allows the construction of apartments and houses in which noise from the outside and from neighbors filters in. Some persons have even taken to adding a low level of constant noise of their own to reduce the annoyance of other noise.

Effects of Noise

Noise can have many adverse effects, including damage to hearing, disruption of normal activity, and general annoyance. Extremely loud noise, such as a sonic boom, can also cause physical damage to structures.

The most common and best understood physiological effect of noise is hearing impairment—either temporary or permanent. The amount of permanent hearing loss produced by sufficient exposure to high-level noise depends on the nature of the noise, the time distribution of particular exposures, the total duration of the exposure over a lifetime, and individual susceptibility. For essentially continuous types of noise, such as that in many factories, enough research has been done to permit some statistical prediction of the risk of hearing damage. More research is needed, however, to predict damage which results from noise of a discontinuous nature.

Noise is known to produce various temporary changes in man's physiological state, in particular a constriction of the smaller arteries. This can mean a speeded up pulse and respiration rate. Some medical authorities believe that continued exposure to loud noises could cause chronic effects such as hypertension or ulcers. Startling noises elicit involuntary muscular responses. Research is still necessary to permit quantitative prediction and understanding of the extra-auditory physiological impact of noise.

More research is needed on the effects of noise on performance of manual tasks. Laboratory studies paint a confusing picture: noise sometimes degrades performance, sometimes improves it. The type of task; the intensity, quality, and repetition rate of the noise; the personality and mood of the worker; and the duration of the task—all seem to interact in unpredictable ways. Workers who must devote constant attention to detail (e.g., console monitoring in quality inspection) may be most prone to distraction. Noise may mask auditory warning signals and thereby cause accidents or cause annoyance and general fatigue.

Individuals vary widely in their sensitivity to noise. A few percent of the population appear not to be bothered by noise, no matter how loud. At the other extreme, a hypersensitive few are distressed by almost any noise. Sensitivity to noise may vary considerably from day to day.

A person may be psychologically predisposed to tolerate and accept a given noise environment when he feels that the noise is an inevitable byproduct of a useful or valuable service. He also tolerates it if his health is not affected and it does not generate fear. One survey of noise around an airport indicated that people's general connection between noise and their fear of aircraft crashing has more effect on the degree of annoyance than did the actual level of noise.

Still another factor is the extent to which people who are annoyed by noise desire to complain and actually do complain about the noise. Complaint data clearly show, however, that new noises will prompt substantial additional response from the community if such noises are heard and identified above the noise level that already exists in the community.

Any characteristic of the noise differing from that to which the community has become accustomed will trigger complaints. New technological developments such as the SST must be examined in light of this phenomenon. Experience has indicated that the new sound of SST sonic booms would not be acceptable to the residents under and adjacent to supersonic flight corridors. (By regulation, the Department of Transportation has proposed banning all overland flights which would produce a detectable boom at ground level.) Similarly, the annoyance levels of noise generated on the sideline areas of the SST on takeoff is currently expected to be three or four times as great as that of the loudest commercial subsonic jets. On the other hand, the SST is quieter along the takeoff path because of its faster ascent. Solutions to the sideline engine noise problem must be developed and effectively applied prior to widespread operation of the SST.

Control and Abatement

Dampening the source noise level or making its noise characteristics less annoying are typical first approaches to noise control. Replacing the noise source with a quieter machine or with one that is no noisier but performs more work (thus displacing many machines whose combined noise levels would be greater than the one) is second, but often costlier approach. Adjusting operating hours to restrict the length or time of day that noise is made is a third approach. Often the simplest solution is to put distance between the noise source and the people—such as truck routes away from residential areas and noisy industry and airports away from homes. This often involves special zoning. Attacking the problem where the noise is heard is often effective. Acoustic insulation (and air conditioning) in residences and offices near airports and highways is one way. Ear protectors for individuals in the industrial work environment is another.

Ultimately, however, decisions must be made as to how much noise must be reduced, how it should be done, who should do it, and who should pay for it.

Implementation of noise abatement and control should not wait until all research is done and all the effects of noise are completely understood. Objective criteria for measuring progress toward the desired reduction of noise can be established without complete understanding of the subjective response to the noise. Working standards can be implemented on the basis of existing knowledge and then refined, if necessary, when more is known. How much noise abatement is forthcoming depends on how badly the public desires more quiet and whether they are willing to pay for what needs to be done.

The recognition of noise as an environmental problem has arrived late in this country, but a beginning has been made toward some of the needed solutions. Of the approximately $34 million allocated by the Federal Government in fiscal year 1970 for noise-related programs, $31 million was devoted to aircraft noise and sonic boom. This comparatively high level of spending reflects the degree of public concern over aircraft noise problems. It suggests, however, that a more balanced research program that deals with all sources of noise is needed. One particularly pressing need is for new research leading to surer health criteria and to a more refined technology to dampen other transportation, household and industrial noises.

Current Action

Although many noise problems are inherently local, the Federal Government has a responsibility to provide leadership in the fight to combat unnecessary noise. It has already taken several steps toward creation of a quieter nation. This progress is reflected in a number of recent moves:

- The Department of Labor, in May 1969, issued the first Federal standards for occupational exposure to noise.
- The Department of Transportation in November 1969 issued the first of a series of noise standards under Public Law 90-411 regulating aircraft noise. In April 1970, the Department issued a proposed rule banning overland flights of supersonic transports.
- In late 1969, the First Federal Aircraft Noise Abatement Plan was published summarizing the overall program for airport noise research and development.
- The Department of Housing and Urban Development (HUD) is preparing to issue a policy circular. It will set uniform policy and lay down interim standards of noise exposure that HUD will use to determine if proposed housing sites are suitable.
- The National Aeronautics and Space Administration in 1969 successfully demonstrated that new technology could be applied to cut down noise in current jet aircraft. Such research continues. This year NASA was authorized to construct a new acoustics laboratory to conduct advanced research on aircraft noise.

State and local governments must play a major role in legislating and enforcing noise control strategies. Most States, for example, have statutes or codes relating to muffler noise on motor vehicles. But the laws usually fail to spell out enforcement techniques and maximum noise levels. Hence, these regulations are almost impossible to enforce. In 1965, New York became the first State to enact a State highway anti-noise statute. In 1967, California enacted an even more comprehensive statute. Its new highway anti-noise statute specifies maximum permissible noise levels for passenger cars, trucks, buses, and motorcycles and prescribes levels and test procedures as a requisite for new vehicle sales.

Many cities have noise ordinances, but few are strictly enforced. Attempts by local governments to control traffic noise are often rejected by the courts. State and local noise abatement efforts have been largely ineffective.

What Needs To Be Done

The Council on Environmental Quality recommends the following:

1. *More research is needed on the physiological and psychological effects of noise in order to develop improved remedial programs.*
2. *Noise standards should be developed for all Federally supported or guaranteed construction.* Such Federal standards might serve as a model to standardize State building noise codes and safeguard the competitive positions in different States of housing and building industries. The Department of Housing and Urban Development is in the process of developing such standards.
3. *A thorough evaluation should be made of the extent of the noise problem, its effects, and the various alternatives open to Federal, State, and local governments and to industry to reduce noise.*

PESTICIDES

When Rachael Carson's "Silent Spring" was published in 1962, man's struggle to protect and reclaim the quality of his environment took on a new dimension. It was no longer just a matter of coping with dirty water and air. Suddenly man was confronted by the distinct possibility that one of his seemingly proudest achievements—the development of pesticides—had set into motion, subtly and invisibly, a chain of biological modifications which could diminish the quality of life everywhere.

Unquestionably, pesticides are, and will continue to be, of enormous benefit to man. They have helped to produce food and protect health. Manmade chemicals have been the front line of defense against destructive insects and rodents. Through pest control, man has modified his environment to meet esthetic and recreational demands.

However, in solving some environmental problems pesticides have created others of yet undetermined magnitude. The unintended consequences of the long-term use of certain pesticides have been injury or death to a variety of life forms. Pesticides have killed shellfish, fish, and birds, and they have caused cancers in test animals. Each year between 100 and 200 human deaths are known to be caused by pesticides in the United States. There are many more acute illnesses, but the statistics are incomplete. Most, if not all, of this morbidity and mortality results from acute poisoning from highly toxic pesticides, sodium arsenite, parathion, and others. There is still relatively little information on the impact of the persistent chlorinated hydrocarbon insecticides, such as DDT, on humans. Consequently, it is not yet known with certainty what are the long-range effects on humans of accumulation of these substances, although some investigators consider that the results from test animals show that a significant threat exists for humans. Such materials accumulate in the body, especially in fat. Investigations show that Americans carry an average of about 8 parts per million of DDT and its metabolites in their body fat. Workmen who handle large quantities of DDT may have several hundred parts per million and still show no harmful effects. The milk of nursing mothers contains DDT. It is also metabolized and excreted in the urine. If exposure decreases, the body concentration diminishes. Therefore, current reductions in DDT use will bring a gradual reduction in body burden, but how fast this may take place is not known.

Pesticides and Their Use

Pesticides embrace a wide variety of chemical compounds for controlling undesirable forms of life which threaten man, his possessions, and portions of the natural environment that he values. A report of the Department of Health, Education, and Welfare Secretary's Commission on "Pesticides and Their Relationship to Environmental Health" of December 1969 pointed to some 900 active pesticidal chemicals formulated into over 60,000 preparations in the United States. In 1968, production and sales of synthetic organic pesticides reached 1.2 billion pounds, of which about 20 percent was exported.

Slightly more than half of all pesticides made are used in farming. (About 45 percent is actually used on crops.) Government agencies use about 5 percent; residential and industrial users account for the rest. At the current growth rate—almost 15 percent a year—a billion pounds of pesticides will soon be applied annually in this country. Most of the increase over the past few years is laid to the expanded use of herbicides. Insecticides and fungicides have not expanded as much. Pesticides can be grouped as nonpersistent, moderately persistent, persistent, and permanent, based on how long they last in the environment. These lifetimes are critical in predicting and assessing ecological effects.

Nonpersistent pesticides last from several days to about 12 weeks. Most are *moderately persistent* with lifetimes of 1 to 18 months. Examples are 2,4–D and atrazine.

Persistent or hard pesticides include most of the chlorinated hydrocarbons. DDT, the most widely used pesticide in the world, and aldrin, dieldrin, endrin, heptaclor, and toxaphene all belong to this family. They are not broken down easily to nontoxic compounds and have persisted in the environment for many years. For example, present information indicates that DDT can remain toxic for at least 20 years.

Pesticides based on toxic, inorganic elements such as mercury, lead, and arsenic are virtually *permanent.*

Nonpersistent chemicals have been replacing persistent ones, particularly in agriculture. The HEW Secretary's report traces shifts in insecticide ingredients between 1964 and 1966 that reflect slight decreases in chlorinated hydrocarbons. Most insecticides used on fruit and vegetable crops are now of the less persistent variety. However, some pests such as termites can still be attacked only with the hard pesticides. The growing public concern with the use of persistent pesticides may accelerate their replacement by other types or other control measures.

Another group of substances which has effects similar to persistent pesticides is the polychlorinated biphenyls (PCB's). PCB's are used in plasticizers, asphalt, ink, paper, and a host of other products. Action is now being taken to curtail their introduction into the environment.

Even pesticides that degrade rapidly are not without serious drawbacks. Many organophosphate insecticides are extremely toxic and nonselective. Places where they are applied are left nearly devoid of insects, including the natural enemies of the intended targets. Since the chemicals then disappear rapidly, fields are extremely vulnerable to new attacks by insects from adjacent areas. Pests always multiply more rapidly than their predators. In addition, insects resistant to the pesticides emerge rapidly. The typical response is to apply heavier doses of the same pesticide at shorter intervals.

Effects of Pesticides

A pesticide may move through an ecosystem in many ways. Hard pesticides ingested or otherwise borne by the target species will stay in the environment, possibly to be recycled rapidly or concentrated further through the natural action of food chains if the species is eaten. Most of the volume of pesticides do not reach their target at all.

Whether pesticides are introduced into the environment by spraying or by surface application, air usually is the medium through which the chemicals move to their intended and unintended targets. Very few data exist on pesticides in the air, largely because of a lack of adequate monitoring. Their presence and fate are functions of their chemical nature, physical state, method of application, and atmospheric conditions. It is clear that pesticides may be blown long distances on dust particles.

The persistence of pesticides in the air is influenced by gravitational fallout and washout by rain. They build up in the soil to concentrations which may eventually reach man by a number of routes: through water drawn from the soil by consumable crops, through leaching or washing into water supplies, and by his direct contact with the soil. Pesticides linger on, often to injure organisms and crops which grow later in the same soil.

Pesticides enter water chiefly through spraying, runoff from treated areas, or waste discharge by producers. Percolation through soil to ground water and accidental dumping are minor sources. Pesticides can reach humans directly through drinking water, but the concentration in most cases is far below toxic level. There is no evidence at present that long-term consumption of such water is harmful, although the buildup of pesticides in water may eventually prove dangerous.

Some pesticides bind tightly to soil particles; therefore, pollution by pesticides may occur from silt and soil washed off agricultural land into rivers, lakes, and coastal waters. Although a portion of the residues is released to the water, some dissolved and some suspended, an unknown amount remains with sediments after they settle. The sediments may then act as reservoirs, continually releasing residue pesticides to the overlying waters.

Initially, low levels of persistent pesticides in air, soil, and water may be concentrated at every step up the food chain. Minute aquatic organisms and scavengers, which screen water and bottom mud having pesticide levels of a few parts per billion, can accumulate levels measured in a few parts per million—a thousand-fold increase. Oysters, for instance, will concentrate DDT 70,000 times higher in their tissues than it is concentrated in surrounding water, but they partially cleanse themselves in water free of DDT. Fish feeding on lower organisms build up concentrations in their visceral fat which may reach several thousand parts per million and levels in their edible flesh of hundreds of parts per million. Larger animals, such as fish-eating gulls, can further concentrate the chemicals. To date, the effects of pesticides have been studied in less than 1 percent of the animal species present in the United States.

Much of the information on the effects of pesticides comes from studies of birds. Heavy mortalities among robins which fed on earthworms contaminated during spraying to eradicate Dutch elm disease spurred the first public concern and scientific inquiry. Many aquatic birds, including egrets, grebes, herons, and gulls, have also died from insecticide poisoning. Much of the drastic loss among certain species of falcons, hawks, and eagles is believed due to the DDT family of pesticides. High levels of persistent pesticides cause some birds to lay eggs with thin shells. There is experimental evidence from the Patuxent Wildlife Research Center that DDE, a metabolite of DDT, reduces the birds' ability to provide calcium for egg shells, causing premature breakage. Ducks, ospreys, hawks, and eagles have all laid thin-shelled eggs. The sudden decline of the Brown Pelican along the southwest coast of the United States is believed to have been caused by widespread breakage of pesticide-affected eggs with shells so thin that they are little more than pliable membranes. As a result, reproduction of the Brown Pelican has virtually ceased. Pesticides affect the nervous systems of both fresh and salt water fish, causing instability, respiratory difficulty, sluggishness, and death. In 1955, when the fish hatchery on Lake George, N.Y., lost 100 percent of nearly 350,000 eggs removed from lake trout, DDT was suspected. Pesticides killed more than 2 million fish in a Florida marsh and over 5 million in the Lower Mississippi River. Laboratory studies show that DDT reduces the ability of salmon to detect temperature changes, an ability upon which they depend to find their spawning grounds.

Some fish may build up a tolerance for pesticides. Mosquito fish have been reported to accumulate endrin at levels sufficient to poison the fish's predators. Concentration of pesticides in big enough doses in edible fish species could pose a threat to food supplies.

Marine invertebrates, such as crabs, shrimps, and scallops, are also susceptible to pesticides, and large mortalities have been reported. Indirect toxicity has taken a toll among crabs feeding on fish killed by dieldrin. And fiddler crabs feeding on DDT-laden detritus became so uncoordinated that they lost their defense mechanism. The growth of several types of oysters was severely retarded in laboratory tests when pesticide levels in the surrounding water were increased.

It is clear that different species respond in different ways to the same concentration of a pesticide. Reproduction is inhibited in some and not in others. Eggs of some birds become thin and break; others do not. Relatively high concentrations of DDT appear in seals and whales. Dead porpoises in the Gulf of Mexico contained residues ranging up to 800 parts per million, but the role, if any, of pesticides in these deaths is uncertain.

Laboratory studies of mammals, including rats, mice, hamsters, dogs, and monkeys, revealed that under experimental conditions some pesticides increased the incidence of cancers, birth defects, and genetic mutation. No clear evidence exists on the long-term effects on man of accumulation of pesticides through the food chain, but the problem has been relatively unstudied. Limited studies with human volunteers during the past 5 years have not shown that persistent pesticides, at the normal levels found in human tissues at present, are associated with any disease. However, further research is required before results are conclusive about present effects, and no information exists about the longer-term effects.

The HEW Secretary's report states: "While there is no evidence to indicate that pesticides presently in use actually cause carcinogenic or teratogenic effects in man, nevertheless, the fact that some pesticides cause these effects in experimental mammals indicates cause for concern and careful evaluation." Further, "the field of pesticide toxicology exemplifies the absurdity of a situation in which 200 million Americans are undergoing lifelong exposure, yet our knowledge of what is happening to them is at best fragmentary and for the most part indirect and inferential. While there is little ground for forebodings of disaster, there is even less for complacency."

Population studies would provide definitive data. But the incidence in man might be so low (one case in 10,000 might be significant) and the period between exposure and observable disease so long that such studies would be difficult to devise and expensive to conduct.

Meanwhile, decisions must be made on the basis of extrapolation from experimental animals. Extrapolation is always risky, and judgments on the chronic effects of pesticides on man will continue to be highly controversial.

Options

Pest control with or without pesticides is essential for protecting man from disease, discomfort, and annoyance and for producing adequate food and fiber. Developing countries with rapidly growing populations, particularly those in the tropics, have a special stake in the battle against pests. A recent report by the World Health Organization stated: "We must not forget the enormous benefits insecticides have brought to humanity. . . . Limitations on the use of DDT would give rise to greater problems in the majority of the developing countries."

A number of choices are available to reduce the dangers of pesticides in the environment. Some persistent pesticides, primarily organochlorine-based insecticides, can be replaced with degradable ones.

Nonchemical methods of pest control are also under development. Federal outlays for such methods have increased to $45 million annually, but with little success. The list of nonchemical controls remains small and almost all have disadvantages. Industry has invested little in this area, so public agencies are left with the leading role in research and development. Many different techniques are under study, including pest control by parasites and predators—such as the use of a species of weavil to combat Klamath weed in California pastures. Introducing pest-killing animals to new areas is risky. The mongoose has itself become a pest in Jamaica and Puerto Rico after having been imported to control rats.

The use of pathogens—viruses, bacteria, and fungi—has had some success. But they may be dangerous to human health. One of the most effective and safest pest control measures is the selective breeding of resistant species of plants. The Hessian fly, a serious pest of wheat, has been controlled in this manner.

Cultural control, based on selection and diversification of planting time, crop rotation, and water and fertilizer management, has proved effective in specific cases. Control of the screw-worm fly through release of many males sterilized by irradiation promises to be dramatically successful. However, this technique or use of chemical sterilants appears to be limited to certain pests and also may be more expensive than the use of pesticides. The HEW Secretary's report called attention to the fact that about 80 percent of the pesticides used are for the control of fewer than 100 species of pest organisms. The report suggests that nonchemical approaches to controlling these specific pests would significantly reduce the pesticide burden.

Shipment of pesticides in interstate commerce is regulated by the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) of 1947, which is administered by the Secretary of Agriculture. The act requires pesticides and other "economic poisons" to carry labels bearing certain information, including any warnings necessary to prevent human injury. A pesticide which fails to comply with the labeling requirement, or which cannot be rendered safe by any labeling, is misbranded, and the Secretary must refuse or cancel its registration as an economic poison approved for shipment in interstate commerce.

The 1954 amendments to the Food, Drug, and Cosmetic Act (FDCA) require the Food and Drug Administration (FDA) to establish residue tolerances for all pesticide products designed for use on or in human or animal food. FIFRA protects interstate commerce; FDCA protects the Nation's health. Any application to USDA to register a pesticide must be accompanied by scientific data on residues that will remain on the crop at marketing time. The FDA must establish the residue tolerance for a particular use before USDA grants the registration. The law provides for seizure and destruction of commodities that contain pesticide residues in excess of established tolerances.

For years FDA has regulated the residues permitted on raw agricultural produce in interstate commerce. An additional problem is how to regulate inadvertent residues on crops from indirect exposure and in fish and other uncultivated foods when the residue accumulation is beyond the control of the harvester. This problem is receiving attention by the FDA. There is also growing concern about human exposures not associated with food (for example, air, water, and clothing). Legislation may become necessary before these hazards can be adequately regulated.

The Department of Transportation (DOT) plays an important role in regulating pesticides. Its licensing of aerial applicators provides the only Federal regulations directly controlling non-Federal use of pesticides. DOT also regulates the interstate shipment of some pesticides as hazardous chemicals and is reviewing and strengthening these regulations.

Significant efforts during the past year to control pesticides include:

- On July 9, 1969, all USDA-operated pest control programs involving nine persistent pesticides were suspended pending a 30-day review of their environmental contamination. Uses of dieldrin, heptachlor, and DDT were drastically reduced or eliminated. In October, the Secretary of Agriculture declared that the Department would "practice and encourage the use of those means of effective pest control which provide the least potential hazard to man, his animals, wildlife, and the other components of the environment."

- On November 20, the Cabinet Committee on the Environment (at that time called the Environmental Quality Council) established a subcommittee on pesticides. As of June 15, the working group of this subcommittee, which consists of pesticide experts, had received for evaluation 45 pesticide programs—embracing 1,033 projects—from 30 Federal agencies. As of that date, 38 of these programs had been evaluated, and significant changes made in many, including substitutions of pesticides and improved control procedures.
- Also on November 20, the White House announced that the Secretary of Agriculture had initiated action, effective in 30 days, to cancel all DDT uses for house and garden pests, shade tree pests, pests in aquatic areas, and tobacco pests. These cancelled uses account for 14 million pounds or 35 percent of the total DDT used annually in this country. However, three registrants have appealed this decision. The DDT products of these three continue to be sold until the courts rule on the appeals. All remaining uses of DDT found to be nonessential will be cancelled by December 31, 1970. The Secretary also announced that beginning in March 1970, action regarding other persistent pesticides would be taken using the same criteria and procedures applied to DDT. A Department spokesman announced at the Senate Commerce Committee hearings in June that within 3 months an evaluation will be completed on the dioxin content in 18 pesticides and their hazards to humans.
- In January 1970, the Secretaries of Agriculture, the Interior, and HEW signed a new interdepartmental agreement designed to strengthen the review of pesticide registrations in relation to the protection of human health and the environment.
- In late February and early March, the Department of Agriculture suspended the registration of 42 alkylmercury fungicide products used for seed treatment. It asserted that growing misuse of the treated seed, despite label warnings and other precautions, constituted an imminent hazard to the public health. This has been appealed, and as of July 1, the appeal had not been decided.
- All uses of aldrin and dieldrin insecticides in aquatic environments were cancelled by the Department of Agriculture. Certain uses of lindane and benzene hexachloride (BHC) on beans,

corn, peas, and citrus fruits were canceled after FDA repealed its tolerance listings for these chemicals. As of July 1, no appeals had been made.

- The Secretaries of Agriculture, HEW, and Interior announced on April 15, 1970, the suspension of liquid formulations of 2,4,5-T for use around the home and of all formulations for use on lakes, ponds, and ditchbanks. The action was taken on the basis of imminent hazard to the public health because of new data which showed that this herbicide caused defects in laboratory animals. Three registrants have appealed the cancellation as it pertains to certain food crops, and their 2,4,5-T products can be lawfully produced and sold pending outcome of the appeal.
- On June 19, the Secretary of the Interior stopped the use of DDT, aldrin, 2,4,5-T, dieldrin, endrin, DDD, mercury compounds, and nine other pesticides on the 356 million acres of public land controlled by the Department.

Forty-eight States have laws, patterned on Federal law, which govern the marketing of pesticides. Thirty-nine States also regulate their use. Most of these States require commercial applicators to obtain licenses or permits. Within the past year, a number of States—including California, Michigan, Wisconsin, and Florida—enacted regulations or laws restricting the marketing or use of certain chemicals, particularly DDT. More such actions are likely.

Public concern is manifested in legal actions initiated by conservation groups. In May 1970, the U.S. Court of Appeals for the District of Columbia ordered the Secretary of Agriculture to suspend the registration of DDT within 30 days for interstate shipment or to show cause why the shipments should continue. As of July 31, the court had not yet heard arguments on the Secretary's reply. The same court ordered the Secretary of HEW to publish in the Federal Register a proposal by an environmental group that the Secretary set a zero tolerance for DDT residues on raw agricultural commodities. This action means that a thorough study and public hearings must be conducted.

Another suit was initiated in June against the Olin Corporation and the Corps of Engineers to halt discharge of DDT from the Olin plant into the Tennessee River and the Wheeler National Wildlife Refuge in Alabama. Shortly thereafter the company closed the plant.

What Needs To Be Done

Although substantial progress is being made in the control of pesticides, much remains to be done. The following represents high priority areas for further action:

1. *The Administration is considering a broad range of legislative and administrative proposals for more effective pesticide regulation.* These include measures to assure adoption of less persistent or toxic materials, limit the availability of certain types of pesticides, and regulate disposal of unused pesticides.

2. *There is a need to ensure that information on the dangers of pesticides and on innovations in pest control is spread worldwide and consideration should be given to international control over use and shipment of pesticides.* Although the need for pesticides may be great in developing countries, the risks to human and environmental health are very great also, and knowledge, techniques, and standards developed in the United States do not necessarily apply elsewhere. For example, recent studies have shown that application of the nonselective, persistent pesticides under tropical conditions in some cases aggravate the pest condition rather than the reverse. New guidelines governing the distribution of persistent pesticides abroad are being prepared by the Agency for International Development.

3. *Incentives to industry should be explored to stimulate research and development by the private sector on substitutes for persistent pesticides and on nonchemical control.*

4. *Finally, the effects of pesticides on man and the environment must be vigorously studied, particularly through controlled exposure experiments.*

RADIATION

In the past when people thought of radiation, they thought primarily of nuclear bombs. Today many still think of it that way. But more and more, Americans are starting to realize that radiation is a byproduct of some forms of our modern technology. Now medical applications are the central source of manmade radiation. Tomorrow increased applications of nuclear power may cause additional concern.

The exposure of larger segments of the world's population—particularly in the industrialized nations—to a variety of low-level, manmade radiation sources is increasing. These sources include X-rays, radioactive materials, and electronic devices in the home, office, and industry. The increase both in the number of sources and in the number of people exposed raises questions about the magnitude and nature of the hazard to human health of ionizing radiation. This questioning has occurred both among the general population and within the scientific community and focuses on the adequacy of existing radiation protection standards.

Effects of Radiation

It is known that high levels of radiation adversely affect human health in a number of ways. Various forms of cancer in humans and experimental animals have been associated with relatively high doses of radiation. It has been demonstrated in leukemia and other cancers that at doses above approximately 100 rems a proportional relation exists between the size of the dose and the incidence of the disease. (The unit "rem" stands for "roentgen equivalent man" and reflects the amount of radiation absorbed in human tissues and also the quality of the type of radiation.) This evidence has been gathered from studies of persons exposed to the atomic bomb explosions in Japan and from patients treated with high doses of radiation for medical purposes.

It is much more difficult to assess the potential biological effects of low-level radiation. Measurements of effects at very low doses (comparable to those which might be expected in the natural environment) are technically difficult or impossible. One reason is that man's biological responses to ionizing radiation depend on myriad factors—type, amount, and rate of radiation received; whether it comes from external sources; and whether the whole body or particular organs are exposed.

One of the major potential effects of low level radiation is that human genes may be damaged or altered. The risk of genetic damage lies behind most of the recommended standards for radiation exposure. There is a natural mutation rate among humans which is believed to be caused, at least in part, by natural background radiation. From this it is reasoned that any manmade sources of radiation which augment natural background radiation will similarly be responsible for a proportionate statistical increase in the number of genes affected. The risk of such an increase argues most strongly for conservative radiation exposure practices.

Information is still not complete regarding potential biological injuries from exposure to radiation from electronic products. Research in this field requires basic and long-term studies of large numbers of humans and animals. The results of preliminary studies on animals show that microwaves of sufficient intensity can induce chromosomal abnormalities, cause cataracts, and alter protein synthesis. Ultrasonic vibrations intense enough to be of therapeutic value can cause tissue damage. However, at this time it appears that nonionizing radiation from sources such as lasers, switching and communications equipment, and microwave ovens has less of an impact on the general population than ionizing radiation.

Sources of Radiation

Natural (background) radiation—The earth's natural background of radiation arises from two general sources. One is cosmic radiation which enters the earth's atmosphere. The dose received at any point on earth from cosmic sources varies with altitude and latitude. The other major source of natural background radiation is radioactive isotopes found in water and in mineral deposits. The total radiation from natural sources can contribute an average individual yearly dose of about 125 mrem (see table 1).

TABLE 1.—*Average Annual Genetically Significant Dose to General Population From Various Environmental Sources* [1]

Source	Dose (mrem)[2]	Percent—	
		Of total from all sources	Of manmade sources
Natural background	125	68. 3	
Medical sources	55. 2	30. 1	93. 8
Diagnostic X-ray	(50. 0)	(27. 3)	(85. 0)
Therapeutic X-ray	(5. 0)	(2. 7)	(8. 5)
Radioisotopes	(0. 2)	(0. 1)	(0. 3)
Other sources	1. 7	0. 9	2. 9
Occupational	(0. 2)	(0. 1)	(0. 3)
Fallout	(1. 5)	(0. 8)	(2. 6)
Miscellaneous (includes TV sets, luminous markings on watches, etc.)	2. 0	1. 1	3. 4
Total		100. 4	100. 1

[1] Based on data reported by John B. Little, "Environmental Hazards—Ionizing Radiation," New England Journal of Medicine, 275, 929–38 (1966) and the United Nations Scientific Committee on the Effects of Atomic Radiation.

[2] mrem=millirem (1/1000 rem).

Manmade sources of radiation—Medical uses of radiation now represent the largest single source of manmade radiation—about 94 percent of all manmade radiation or roughly 30 percent of all radiation sources to which the average person is exposed. An increasing awareness of this fact and its potential hazard has led to some reduction in medical uses of radiation in recent years and to improvements in their techniques of use.

Radioactivity released during past atmospheric nuclear tests currently contributes about 3 percent of the manmade radiation to which individuals are exposed. The radioactive fallout of main concern from these tests is strontium-90 and cesium-137. Their half-lives, 28 and 30 years, respectively, mean that they will exist in the environment for many years. A significant amount of tritium produced by atmospheric weapons testing also remains in the biosphere. The U.N. Scientific Committee on the Effects of Atomic Radiation reports that individuals who lived in the United States during the period of heaviest fallout in the 1950's and early 1960's will accumulate a total genetic fallout dose of about 110 millirem by the year 2000. This is approximately what man is already receiving annually from natural background radiation. This "extra year" of exposure takes into account all sources of fallout, including radioactivity which may enter the body through food and water.

Nuclear powerplants provided about 1.4 percent of the country's total electric power capacity in 1969. The U.S. Atomic Energy Commission estimates that nuclear plants will furnish almost 25 percent of the total in 1980 and between 60 and 70 percent by the year 2000. With the projected substantial increase in demands for electric power, environmental problems arising from the operation and siting of all powerplants will require careful scrutiny, since both fossil fuel and nuclear plants can cause adverse environmental effects.

Effluents from nuclear power reactors contain small amounts of radioactivity. Two significant isotopes, krypton-85 and tritium, are released mainly from fuel reprocessing plants and to a much lesser extent from nuclear reactors. AEC experience with commercial reactors shows that exposure to persons living near a typical operating reactor may range from 1 to 10 mr per year. In March 1970, the AEC announced proposed amendments to its regulations. These would improve the framework for assuring that even within regulatory limits, reasonable efforts are made by licensees to keep exposures to radiation and releases of radioactivity in effluents from light water-cooled nuclear power reactors "as low as practicable" consistent with Federal Radiation Council guidance. Two of the four suppliers of water-cooled reactors have already announced that they are designing systems that should be capable of further reducing the effluent levels.

Because krypton is long-lasting (half-life of 10.76 years) and does not react chemically with other substances, its quantity in the atmosphere is increasing. There is no evidence that it can concentrate through food chains. Estimates indicate that by the year 2000 the average annual genetic dose to the population from krypton-85 will be about 0.02 mrem, assuming that it continues to be fed into the atmosphere.

Tritium (half-life of 12.26 years) is extremely difficult to remove from the liquid discharges of power and fuel reprocessing plants. However, the addition of tritium to the environment is not expected to increase the world population's radiation exposure significantly. There is no known mechanism by which tritium can concentrate in fish and shellfish or other food chains, and studies show no evidence that it does concentrate. If one assumes that tritium from nuclear plants is diluted in the oceans to a depth of 40 feet and in the atmosphere to a height of 10 kilometers, the resulting population doses are estimated at 0.002 mrem per year by the year 2000.

Reactor Safety Record

A nuclear reactor cannot explode like an atomic bomb. The most serious safety hazard it poses is that excessive heating could melt the core and spill large quantities of radioactive materials into the environment. To make this possibility extremely remote, an extensive safety program has been developed.

Since the beginning of the nuclear energy program in 1943, there has been only one reactor accident in the United States involving fatal injuries. This accident occurred in an experimental reactor, the SL–1, at a remote AEC testing station in Idaho in 1961. It killed three reactor operators. A very small amount of fuel melting occurred in the Enrico Fermi reactor near Monroe, Mich., in 1966, but no radioactivity was released from the plant. In the commercial nuclear power program, no radiation injuries or deaths have resulted from the operation of licensed nuclear powerplants in the United States. There have been other deaths from high-level radiation not associated with reactors.

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Radioactive Waste Storage and Disposal

The management of radioactive waste material in the nuclear energy industry can be put into two general categories. The first is the treatment and disposal of materials with low levels of radioactivity. These materials are the gaseous, liquid, and solid wastes from reactors and other nuclear facilities. The second category involves the treatment and permanent storage of much smaller volumes of wastes with high levels of radioactivity. These high-level wastes are byproducts of the reprocessing of used fuel elements from nuclear reactors. Their disposal will become more and more of a problem, particularly as their volume increases with society's expanded uses of radiation sources in the future.

Low-level wastes—Reactors are permitted to release low concentrations of radioactivity to the atmosphere and to receiving waters. These amounts are generally well below the limits specified in regulations issued by the AEC.

Low-level solid wastes are packaged and shipped for storage at AEC-owned or AEC-licensed burial sites. There are currently five licensed private sites and five AEC-owned burial sites in use. They are located on Federally or State-owned land and were chosen so that the local geology and hydrology are least likely to allow the buried radioactivity to escape. A close watch is maintained to assure that leakage does not occur. About 650,000 cubic feet of low-level solid wastes were buried at licensed burial grounds in 1969. The total of solid wastes for AEC sites was about 1,800,000 cubic feet.

High-level wastes—After used fuel is removed from the reactor, it is packaged and shipped in solid form to a reprocessing plant. After reprocessing, the high-level liquid wastes are concentrated and stored in tanks under controlled conditions at the site of the reprocessing plant. In anticipation of the growth of the nuclear industry, the AEC has developed the technology to reduce these liquid wastes to solid form, thereby reducing the final volume to one-tenth that of the original liquid material. The liquid wastes (approximately 80 million gallons) stored at AEC sites are now in the process of being solidified. The AEC has announced a proposed policy that will require high-level wastes from the reprocessing of commercial reactor fuels to be stored in solid form. (Approximately 520,000 gallons are now in tank storage at the one licensed fuel reprocessing plant site.)

It has been estimated that through the year 1980, commercial power reactors will generate approximately 3.5 million gallons of high level wastes. Upon solidification, it would be equivalent to a cube about 33 feet on a side, or 35,000 cubic feet.

Standards for Protection Against Ionizing Radiation

The formal procedures and scientific bases for developing and establishing standards for protection against ionizing radiation are the most comprehensive of any applied to environmental stresses. However, the effects of radiation on man are not fully understood, and there remains room for disagreement over the adequacy of current standards.

Radiation exposure standards are re-examined as knowledge expands. Although the biological effects on man of low-level exposures have not been precisely quantified, current standards use a conservative extrapolation of measured data at high exposures to set radiation standards of low levels. Further, as advised by the Federal Radiation Council, efforts are made to keep exposures as low as practicable. Experience has shown that actual exposures are small fractions of radiation protection standards. However, as the number of radiation sources grows (for example, nuclear power plants), increasing attention will have to be paid to the apportionment of radiation doses from these sources.

Despite this conservatism, some scientists have questioned both the rationale and the levels of existing standards. The State of Minnesota has proposed radiation standards more stringent than those established by the Atomic Energy Commission. The AEC argues that the Atomic Energy Act gives it exclusive authority to establish radiation protection standards, but this prerogative has been challenged by Minnesota. The issue is currently being litigated in the courts of that State by a private utility in a suit against Minnesota.

The continued increase in the use of radiation sources will undoubtedly lead to increased concern over radiation standards, and the need to determine more precisely the effects of low-level doses will become even more urgent than it now is.

What Needs To Be Done

To assure that adverse effects due to radiation are kept to an absolute minimum, the following are necessary:

1. Continued research to determine the effects of low-level doses of radiation and their cumulative effects.

2. Intensified research on problems of radiation arising from medical uses and from consumer products.

3. Careful regulation and control of the release of radiation to the environment from nuclear reactors, underground nuclear testing, and the transportation, storage, and disposal of radio-active wastes.

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VIII

Population, Growth, and Resources

As population grows, it creates more environmental problems and intensifies those that are already there—just by dint of its growth. For all the decades of the country's national existence, population growth has been in a steady spiral. As it grew, there were more people to want more services, which can only come from natural resources. In those nearly two centuries of growth, Americans took what they wanted with little counting of the cost in natural resources and the toll this took on the environment.

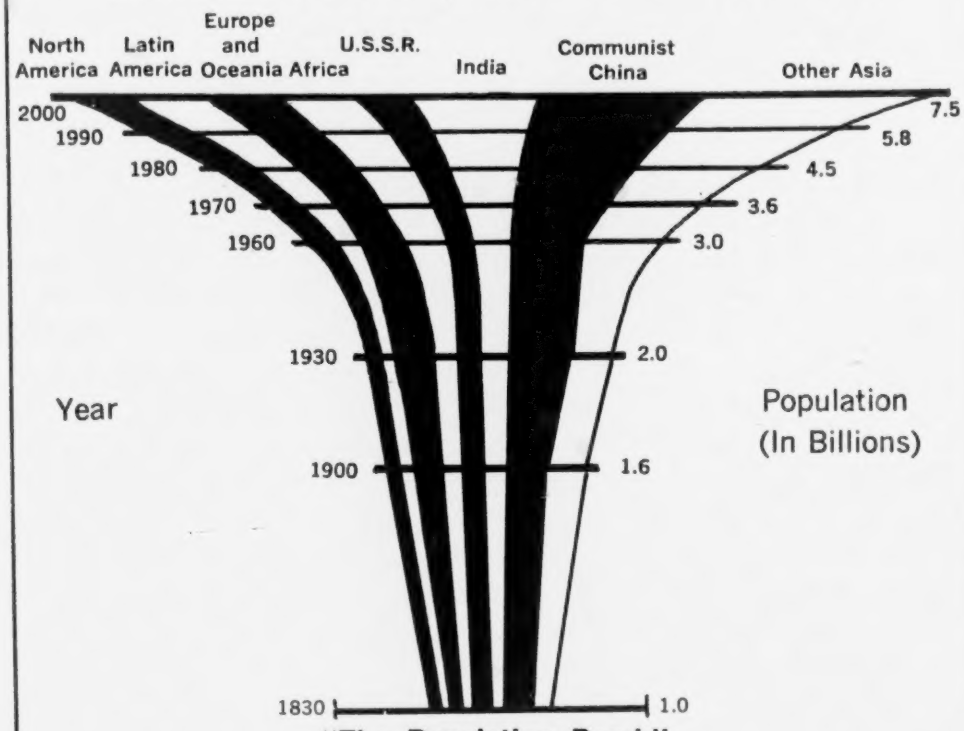
We have wanted automobiles, TV sets, and household appliances and a variety of clothing, food, and housing. We have wanted to flip on a switch and immediately have electricity or to turn on a faucet and have an unlimited flow of water at low cost. And we have wanted to dispose easily and rapidly of personal, household, and industrial wastes produced by our style of living.

POPULATION AND GROWTH

Between 1830 and 1930 the world's population doubled from 1 to 2 billion. By 1970, it had almost doubled again, reaching 3.6 billion. Between now and the end of the century, a mere 30 years, it probably will more than double again—barring catastrophe or a marked change in values—to an estimated 7.5 billion. The U.S. population is growing less rapidly than that of most of the rest of the world, but the increase is still significant. One hundred million people lived in the United States in 1915. The population has passed 205 million today and may reach between 265 and 322 million by the end of the century.

Population growth was of little relevance and of no concern to man during the first several hundred thousand years of his existence. Less than 200 years ago, some of the negative implications of population increase first began to be realized.

Growth of World Population to the Year 2000



"The Population Bomb"

Source: Department of State.

Although the rate of population growth in the United States and other industrial nations has declined, its absolute growth hasn't. And that contributes to environmental decay. More people mean more congestion, more urban sprawl, and vast networks of highways to transport them. They require more goods and services—more steel, more paper, more cars, and more beer cans. And they put more severe demands on urban land. Moreover, people themselves produce waste that must be handled by treatment plants.

Mushrooming population growth doesn't necessarily mean more polluted air and water. But it is more difficult to have environmental quality with the pressure of population. It is more difficult to avoid congestion, preserve green space and keep a pleasant environment. Whatever the environmental problem, rising population requires effort just to stand still and great effort to make progress—requiring institutions not now available and management tools not yet perfected.

Population Control—A Matter of Values

The increased attention focused on the environment has already changed values in American society. Increasingly, concern has shifted from quantity to quality and from the desirability of growth to the desirability of stability. These are not absolute alternatives, but rather broad differences in emphasis. The quantitative increase in GNP has generated significant qualitative improvements in the way people live, and certain kinds of growth are necessary for the stability of society. However, the significance of values in determining population policy should not be underestimated.

Quantitatively Americans have achieved heights which could not be imagined only a few decades ago—metropolitan areas of unparalleled size, a GNP approaching a trillion dollars a year, and consumption of goods and resources on a scale far exceeding that of any other society, past or present. Although growth has been accompanied by a better life in some ways, growth has not led to a high quality environment. It has become clear that a finite planet cannot withstand infinite population growth.

An optimum population range is a matter of considerable dispute. Many feel that the country has already reached the desirable limits of growth, and their view may come to be generally accepted. It is not generally accepted now, however, and evidence to indicate what the optimum population should be is scanty or nonexistent. The work of the President's Commission on Population Growth and the American Future should help explore this question.

How much time the United States has to deal with the size of its population depends on the view of the optimum population range. However, two things are clear—there is some limit beyond which the population should not go, and it will take a considerable time to achieve a stationary population when, and if, it is decided that this is a desirable goal. Even if fertility rates were to fall immediately to levels required for "replacement" of the existing population (2.11 children per woman), given the large proportion of Americans currently of child-bearing age, the population would continue to increase for over 60 years and would level off at about 275 million. It is possible that fertility rates could drop below the replacement rate, in which case the population would level off sooner and at a lower figure.

Some steps are now underway which may reduce the rate of population increase. Research is being conducted on improved methods of contraception. If an inexpensive and effective method with no adverse side effects is developed, it will contribute significantly to population control. Some demographers estimate that about 20 percent of the children born in the United States are unwanted. If they had not been born, the average family size would be close to the figure needed for population replacement. Thus a situation of "perfect contraception" might bring the birth rate close to what is needed for zero population growth—unless other factors intervene.

One method of avoiding unwanted births being widely discussed today is abortion. In the past few years, a number of States have liberalized their abortion laws, and the movement toward liberalization or complete abolition of such laws is continuing. This movement could bring a significant decrease in the rate of population growth.

There has been some talk about the effects of economic penalties or incentives on family size, but there is almost no good evidence on what the effects are. Federal tax policy theoretically encourages people to get married and to have children by taxing single persons more heavily than families and giving a significant deduction for each dependent. However, the tax relief from having children is small compared to the cost of rearing them, and it is questionable whether the marginal economic effects of tax policies can or do have much impact on family size.

The major key to achieving a stationary population lies in the values which people hold. Most couples in the United States still want more than two children, and so long as this is true, the population will continue to grow. Values concerning family size cannot be changed directly by public policy, but there are measures which can be taken to influence such values. One, for example, would be to improve training and employment opportunities for women, opening up for them many acceptable roles other than rearing children. There are now only half as many women as men enrolled in colleges and universities, and only 10 percent of the students in professional schools are women. Opening more career possibilities for women would move the country toward a wider range of family size, since some career women will choose to have no children, and at the same time would make available to the Nation a valuable and underutilized pool of talent. Increased employment for women would also provide an indirect economic incentive for smaller family size because of the finanical loss involved in dropping a career to rear children. Unlike taxes, such an incentive might be sufficiently large to influence the number of children a woman will have.

The broad problem of population growth will be studied by the President's Commission on Population Growth and the American Future, headed by John D. Rockefeller III. That Commission will explore the implications of future population growth and make recommendations to the President within two years.

People on the Move

The U.S. population is geographically mobile. From its earliest days the Nation has undergone great movements of population to different parts of the country. Such movements are still going on. Significant numbers of people are moving from the interior to the edges of the country (Atlantic Seaboard, Florida, the Gulf Coast, the West Coast, the Southwest, and the Great Lakes regions), from rural areas to cities, and from central cities to suburbs.

The implications of these movements are hard to discern. They are obscured partially by differences in focus and interpretation. If one looks at the national population, an ever higher proportion of the people are living in large metropolitan areas and thus are exposed to dense concentrations and the problems of urban living. However, within the metropolitan areas the general trend is toward steadily lower densities (fewer persons per square mile) because of suburbanization. Nationally, there has been fairly constant economic growth, but certain regions (Appalachia, parts of the South, and New England) suffer chronic problems of poverty. Although the population as a whole is highly mobile, residential segregation of blacks has increased. The population of the country is increasing rapidly, but between 1960 and 1970 half of the counties in the Nation lost population.

These differing trends and other related factors make it difficult to weigh the advantages and disadvantages of increasing urbanization. Much more thought and research needs to be devoted to how and in what ways the Federal Government should influence patterns of population distribution.

The ills which beset both urban and nonurban areas are numerous and familiar; examples will be found throughout this report. Many of these problems, particularly those relating to metropolitan areas and to environmental quality, arise from an absence of rational, enforceable planning. The structures of local governments and taxes work hand-in-hand to undermine the application of foresight to urban development. Insufficient open space is provided, jobs are created without regard to residences of potential employees, and transportation networks are built with little thought of their social or environmental consequences.

Many of these problems are related to population growth in metropolitan areas. But they are also clearly related to the inadequacy and ineffectiveness of local and regional planning. This aspect of urban development will be discussed in more detail in the chapter on land use.

The GNP—Does It Hurt or Help?

Economic growth is closely linked to population growth. Some conservationists and ecologists believe that the Nation should aim at zero GNP growth as a way of avoiding ecological catastrophe and preserving a decent environment.

Economic growth is often accompanied by more industrial pollution, greater consumption of natural resources, and larger quantities of discarded materials. If the sole objective were pollution abatement or the conservation of natural resources, a reasonable argument could be made for reducing GNP to the lowest levels possible.

However, this report is taking a broad view of the term environment, and this broader view reveals many benefits of continued economic growth. Our society needs more goods and services of many kinds—better housing, improved public transportation, more adequate facilities for health and education, and increased pollution control. It is likely that the funds for such investments will come not from a cutback in the production of cosmetics, for instance, but from an overall increase in national output. Moreover, a reduction in growth would result in a severe blow to the aspirations of the economically disadvantaged, especially minority groups.

Thus, looking at the total environment of the Nation, it seems probable that direct attempts to reduce GNP growth would create many more problems than they would solve. If the rate of population growth is reduced, there will undoubtedly be some reduction in the rate of GNP growth, but environmental problems probably can be dealt with most successfully by alterations in the composition of the GNP, particularly alterations in that portion of GNP which represents growth over the current level.

1968 GNP by Industry, in 1958 prices

[In billions of dollars]

Agriculture, forestry, and fisheries	24.9
Contract construction and mining	[1] 34.0
Manufacturing	229.5
Transportation, communication, and utilities	74.9
Wholesale and retail trade	123.3
Finance, insurance, and real estate	99.9
Services	67.8
Government and government enterprises	70.0
Rest of the world	3.9
Residual	[2] 7.7
Total	735.9

[1] Specific figures for contract construction and mining as separate categories are not available.

[2] Difference between gross national product measured as sum of final products and gross national product as sum of gross products by industries.

Source: Department of Commerce, Office of Business Economics.

The composition of gross output in the United States is constantly undergoing change. From the standpoint of environmental quality, two likely changes in the GNP makeup are especially noteworthy. On the one hand, there will be increased expenditures specifically for protecting or improving environmental quality. The costs of pollution control, of ultimate disposal of products, and even of esthetic attractiveness will have to be reflected in the price of some goods. Although the increased expenditures will be counted as GNP in the year in which they occur, they will divert funds from investment in facilities to produce goods and, hence, may actually reduce GNP in future years.

The other set of changes involves the increasing shift in the proportion of GNP devoted to providing services as against the production of goods. Almost all of the increase in employment in recent years has been accounted for by increases in the service occupations. This has been and will continue to be reflected in the GNP. One result will be a reduction in the adverse environmental effects of increased national product since most such effects arise from manufacturing processes.

The shift to services should not obscure the extraordinary increases in output which can be anticipated in many nonservice sectors of the economy. In some cases where the environmental consequences are extremely damaging and are also unavoidable given current technology, the choice between increased output and environmental protection may have to be made. We already have begun to see isolated instances of production facilities being closed or being prevented from being built because of their adverse environmental effects.

Anticipation of the possibility of having to curb firms and industries should provide a spur to research and regulatory efforts so that such a possibility does not become a reality. The choice between environmental deterioration and economic deprivation is one which should and can be avoided.

The potential uses of the economic system in controlling pollution should not be overlooked. A wide variety of economic incentives may be useful for preventing the introduction of wastes into the environment and for overcoming the incentives to pollute which are built into the present pricing system. This report notes several such possibilities, and the Council is working on other similar proposals. In dealing with environmental problems focusing on structuring economic incentives is far more productive and beneficial than worrying about the overall growth of the economy.

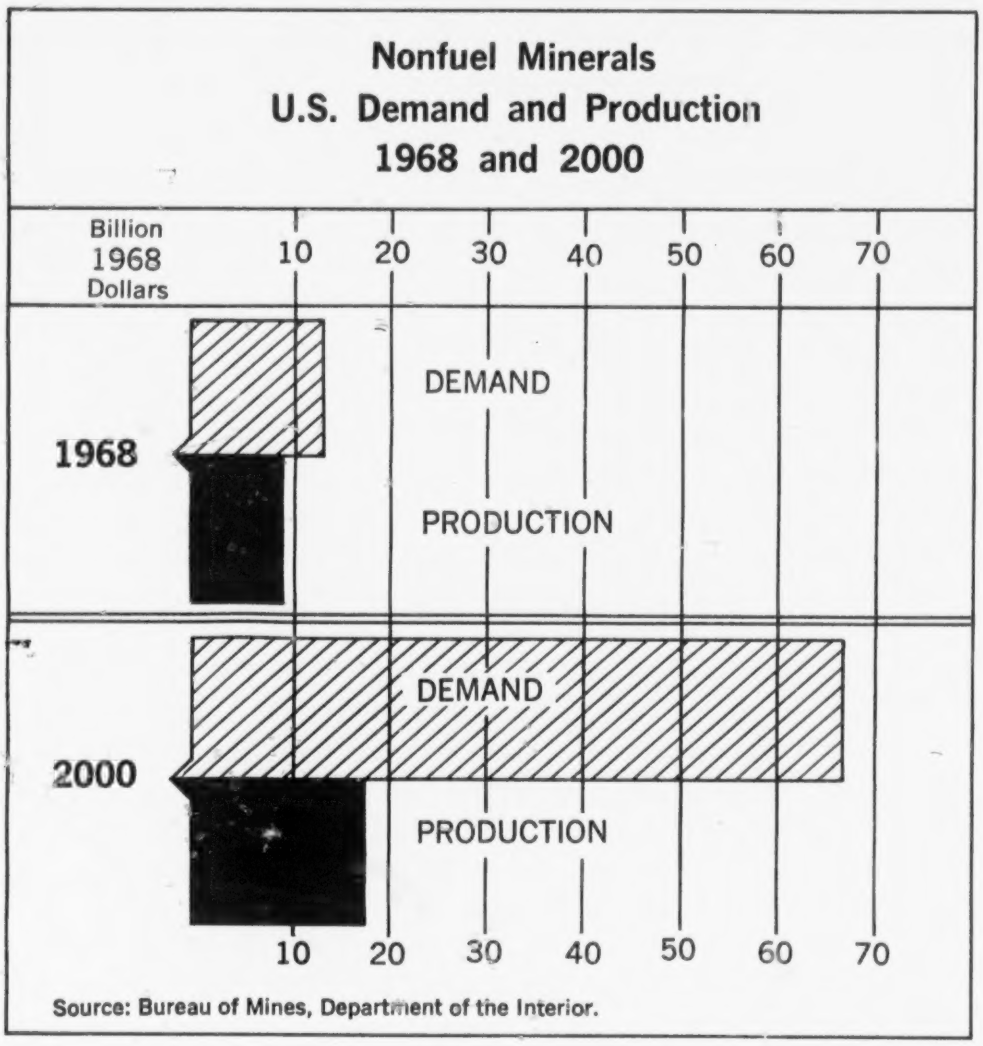
NATURAL RESOURCES

The quality of life depends substantially on the availability of a wide variety of natural resources. Their availability provides the basis of the economy, and influences daily life in innumerable ways.

A comprehensive assessment of the current status of natural resources is beyond the scope of this report. However, a brief analysis of some of these assets may help to place the resource status of the Nation in perspective. One major document on this matter was published during 1969. A special joint committee of the National Academy of Sciences-National Research Council prepared the report, "Resources and Man." It is a sobering statement on resource availability. Other writers have spoken in still more alarming terms, fearing that a crisis is imminent; still others have confidence that the capability of the American society for adjustment and innovation is great enough so that many present trends will not continue to the point of ruin.

Our Diminishing Minerals

Estimates of the world reserve supply of mineral resources are extremely difficult to make. Most of the important minerals are found in workable concentrations in relatively limited portions of the earth's



Source: Bureau of Mines, Department of the Interior.

crust. In some cases, minerals exist in low concentration which could become workable as the price rises. Even taking into account such economic factors as increased prices with decreasing availability, it would appear at present that the quantities of platinum, gold, zinc, and lead are not sufficient to meet demands. At the present rate of expansion of about 6 percent a year, silver, tin, and uranium may be in short supply even at higher prices by the turn of the century. By the year 2050, several more minerals may be exhausted if the current rate of consumption continues.

Faced with dwindling supplies, one or more of the following alternative courses of action will have to be followed: Reduce dependence on the technologies using these materials, seek substitutes, seek new supplies, seek new extractive techniques, or recycle minerals. Mineral substitutes are being sought by industry, but many minerals are likely to become so scarce that even the substitutes may have a short life. Some substitutes present particularly difficult problems. For example, the widespread use of plastics has created solid waste disposal problems. Substitutes may not be available at all for some materials such as mercury and helium which have special properties. Despite spectacular recent discoveries, there are only a limited number of places left to search for most minerals. Geologists disagree about the prospects for finding large, new, rich ore deposits. Reliance on such discoveries would seem unwise in the long term. Extraction of minerals from some large reserves of very low-grade ores may become economically feasible in the future. However, the techniques of extraction themselves may pose significant environmental problems. For example, the power requirements for extraction may be immense. That would add to thermal pollution. In addition, the yield of waste products can be substantial. It seems desirable from the conservation viewpoint to obtain large fractions of our mineral supplies from recycling metals.

Statistics on the recycling of scrap metals are presently inadequate. The contribution of scrap to domestic smelting of iron and lead has declined since 1960. That of copper has increased from about 37 percent to about 46 percent in the same period and that of aluminum from 14 percent to 19 percent. There is room for the development of a substantial industry in recycling.

Recycling of minerals would also appear to be desirable in view of a lessened environmental impact. The amount of waste products that must be disposed of is reduced, and the energy requirements for recycling appear to be less than those required for primary production. In the longer term, there appear to be no adequate substitute to recycling.

Energy—An Environmental Battleground

The conflicts between the consumption patterns that we all want and the environmental ill effects that we all wish to avoid is sharper for energy than for perhaps any other aspect of natural resource use. On the one hand, everyone wants to use as much electricity as he needs for consumption or production, whenever he wants it; yet few love a power plant or a transmission line. Similarly, each individual desires ample power for pleasant driving; yet no one consciously wishes to contribute to air pollution and traffic congestion. The prices consumers pay for these goods and services do not reflect the damages they cause to the environment.

In recent years there has been a rapid upward surge in demand for electricity, caused not only by rapid population growth but also by the successful efforts of utilities and appliance manufacturers to promote new uses for electricity. For example, since 1964 annual sales of window air conditioners have increased from 2.75 million units to almost 5 million.

During the past year, there has been a great upsurge in public controversy over the locations of new power plants. Public objections on environmental grounds are delaying construction of new facilities at many sites. Industry is genuinely concerned over its ability to meet consumer demands in 1970 and in successive years. Utilities are producing 75 percent more electricity nationally than they did in 1960. But power reserves in many regions are below the 15 to 20 percent reserve which the Federal Power Commission considers adequate. The situation in some regions is worse than these national figures suggest, for inadequate capacity is concentrated in some regions; 39 of the 181 major power systems in the country have reserves of less than 10 percent. Since the Atlantic coast blackout of 1965, there have been 37 major power failures and numerous local power disruptions; in addition, there have been brownouts in which customers are asked to restrict their use of electricity. In the spring of 1970, several metropolitan areas along the Atlantic coast were put on notice that home power consumption during the daytime would have to be restricted during the summer.

Part of the objection to powerplants and powerlines is esthetic; few regard them as an addition to the beauty of the landscape. But some of the objection is based on other environmental grounds. High sulfur coal and oil plants pollute the air with oxides of sulfur and small particulate matter and thus are a major source of air pollution. Another principal problem is their need for cooling water and the effect of returned heated water on stream, lake, and bay ecosystems. Food chains can be interrupted if chlorine is required to keep down algae growth in the circulating chambers. The long-term problem of thermal effects on air requires intensive study and continuous monitoring.

If a crisis between rising demands for electricity and environmental ill effects is to be avoided, then a massive effort must be made to find powerplant locations where both minimum damage to the environment and maximum public acceptance are possible.

Other sources of energy for electric power generation also present problems. Hydropower possibilities have largely been exhausted, and further developments would alter the free-flowing character of the remaining unaltered streams. Solar energy, tidal generation, and geothermal sources appear unpromising on a large scale without technical breakthroughs that are not even on the horizon. The development of magnetohydrodynamics (MHD) as an energy source is currently the subject of extensive research. Fossil fuels are finite in amount. The earth's coal supplies are sufficient to serve as a major source of industrial energy for a few hundred years. Petroleum can be expected to supply its present large fraction of total power needs for a limited time. And natural gas is our scarcest fuel resource. Although no crisis exists this year or this decade, the time is surely coming, perhaps within the lifetime of persons now alive, when petroleum can no longer play the major role in providing needed energy. Even coal must some day yield its large role in energy supply, though that day is further off.

Nuclear power presents a more optimistic picture for the longer run future. Although the supply of uranium 235 is limited, the prospects for development of nuclear breeder reactors capable of consuming natural uranium and thorium are reasonably good. Renewed optimism is also felt for the development of nuclear fusion as a major source of power for a still longer run future. If these sources develop, more effort will have to be put into the radioactive waste disposal problem.

Petroleum is at present the best fuel for autos, and no commercially feasible substitute has yet been developed. But petroleum suffers from several major disadvantages. It is a major source of air pollution, although the automobile engines of the future may remove most of this disadvantage. And its transportation presents hazards of pollution, whether by pipeline from offshore wells, or across land, or by tanker on the seas. The oil spill off Santa Barbara in January 1969 and many spills in the Gulf of Mexico in later months dramatized the potential dangers of oil production and transportation. Concern is great in many quarters over the ecological damage possible from a pipeline break in the fragile tundra area of Alaska or from a tanker collision in ice-strewn waters.

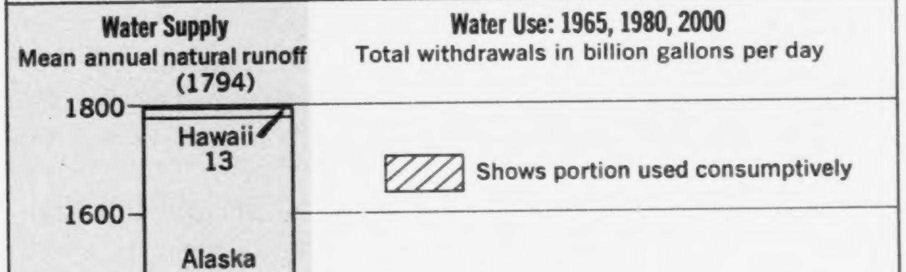
All in all, the short-range energy situation seems tolerable with the exception of the environmental ill effects. The longer run outlook causes more concern, as does the need to provide the research base and the climate of public opinion for major future shifts in energy sources. These research and public opinion factors force us to take a closer look than the immediate present.

Water—Workhorse of the Environment

Water is used for many purposes: In agriculture, for irrigation; in industry, as a cooling medium as well as directly in many industrial processes; in the home, for varied domestic and personal needs; and, almost everywhere, as a medium for carrying away wastes of all kinds. The use of water is rising for almost all these purposes in nearly all parts of the country. For example, in 1969, domestic use of water increased by about 1.5 percent; agricultural use by approximately the same amount; and industrial use by about 2.5 percent.

In the past, the Nation has used water lavishly, in part because it was blessed with a large supply. For many decades, water was the classic free good, widely and easily available as needed. But that day has passed, and increasingly stringent water problems are arising. Present use exceeds, or shortly will exceed, available supplies in much of California, the arid Southwest, and some parts of the Middle Atlantic States. Some of the demand has been met by drawing on groundwater reserves, but this obviously cannot continue indefinitely unless the water drawn from aquifers is replaced. Groundwater levels have been drastically lowered in some areas, particularly where heavy irrigation demands have been met by pumping in excess of recharge. For example, in an area 100 by 300 miles in southern California, levels have been lowered by as much as 200 feet. In some such areas, the surface of the ground has subsided as the groundwater was drawn out, in turn producing serious disruptions of activities on the land surface.

U.S. Water Supply and Projected Water Use



Water User			
Rural Domestic	2.4	2.5	2.9
Municipal (public supplied)	23.7	33.6	50.7
Industrial (self supplied)	46.4	75.0	127.4
Steam-electric power	84.5	193.3	470.4
Agriculture	112.6	138.2	153.2
Total	269.6	442.6	804.6

Source: Water Resources Council, 1968 National Water Assessment.

As water use increasingly presses on water supplies, various adjustments in its use and reuse will become necessary. The present lavish use is in large part related to the present low or modest cost of water. If water costs were higher, many ways to use less water would doubtless be found. For instance, the technical problems of recycling cooling water can usually be solved if it becomes profitable to do so. A relatively modest increase in water price will often be the decisive factor. This will become particularly important for the electric power industry, which today is such a large user of cooling water. Industrial and domestic water can be purified and recycled in most cases if the cost or availability of water so requires. "Used water," or purified and recycled water, will necessarily become more common. Unless it does, large areas in California and elsewhere will face serious water problems in another decade or two.

As with various other natural resources, the water supply situation today is not generally critical, although some serious local and regional situations exist. It is the future suggested by present trends that provides the greater concern and the need for more effective action in water conservation.

Forests—A Renewable Resource

Forests are an old natural resource, long of major value to many people. But today forests are being exposed to new and urgent demands which create many management problems.

The availability of wood fiber for lumber, plywood, and pulpwood is reasonably satisfactory. For the past decade or more, the annual growth of wood fiber has been greater than the annual loss from cutting, fire, insects, and disease. As a result, timber inventories have been building up, following many decades when they declined. The volume of standing timber is normally so large in relation to annual growth that year-to-year changes in standing volume are not great. Over the past decade, there were no major changes in stock of timber or in acreage of forested land.

The situation today only partly shrouds problems that may grow more intense tomorrow. Future demands in the construction industry are sure to place increased demands on the Nation's forests. The needs for housing directly conflict with the interest of those who work to preserve the forest. In the West, cutting of old growth timber is reducing timber stands faster than they are growing; in the South and East, timber is growing faster than it is being cut. But the heavy cutting is in timber species, tree sizes, and log qualities which are not being grown in large volume. The excess is largely in less desirable species, consists of smaller and lower quality logs, and is generally less valuable wood than that which is being cut. If one considers only volume of wood fiber, the picture looks good; if one examines the kinds, qualities, and locations of that fiber growth, a less satisfactory situation surfaces. Moreover, a great deal of forest land is stocked at less than optimum, and some land capable of growing trees needs reseeding or replanting.

Lumber production, however, is only one of a number of values realized from the forest resource. Other resource values which forests provide include watershed areas, wildlife habitat, recreation opportunities of many types, grazing land for domestic livestock, and local climatic moderation. Good forest management is no longer synonomous with timber production. The emphasis increasingly is on multiple use management, although it is important to recognize that the same piece of land may not simultaneously support all types of use. The increasing human population places a continually rising pressure on the forest resource. And a higher degree of planning is required to assure that these needs are met without severe damage to this resource.

CONCLUSION

Many traditional assumptions are being questioned, and our attitudes toward population growth, economic expansion, and the use of natural resources are no exception. We have begun to ask what the optimum population of the nation or of a given metropolitan area *should* be. We are looking more critically at proposals for the construction of new power plants or factories and asking what the environmental effects of such projects *will* be. We are gaining an increased sophistication about our consumption of natural resources and a better understanding of the limited availability of natural resources. We must begin to translate these new attitudes into effective long-range policies if we are to achieve the goal of a satisfactory environment.

IX

Land Use

The first men upon this land, the American Indians, treated it with reverence, blended with it, used it, but left hardly a trace upon it. Those who followed have been less kind. They brought with them a different creed which called on man to conquer nature and harness it for his own use and profit.

Now more than halfway into the 20th century what they have done is being turned back upon them. Misuse of the land is now one of the most serious and difficult challenges to environmental quality, because it is the most out-of-hand, and irreversible. Air and water pollution are serious, hard to manage problems, too. But they are worked at with standards, with enforcement tools, and by institutions set up for those specific antipollution purposes. Land use is still not guided by any agreed upon standards. It is instead influenced by a welter of sometimes competing, overlapping government institutions and programs, private and public attitudes and biases, and distorted economic incentives.

The 50 States comprise about 2.3 billion acres of land. Of that, 1.9 billion acres lie in the contiguous 48 States. Nearly 58 percent of the land area is used for crops and livestock. More than 22 percent is ungrazed forest land. Less than 3 percent is in urban and transportation uses, although it is increasing. Areas designated primarily for parks, recreation, wildlife refuges, and public installations and facilities account for about 5 percent. The rest—12 percent—is mainly desert, swamp, tundra, and other lands presently of limited use by man.

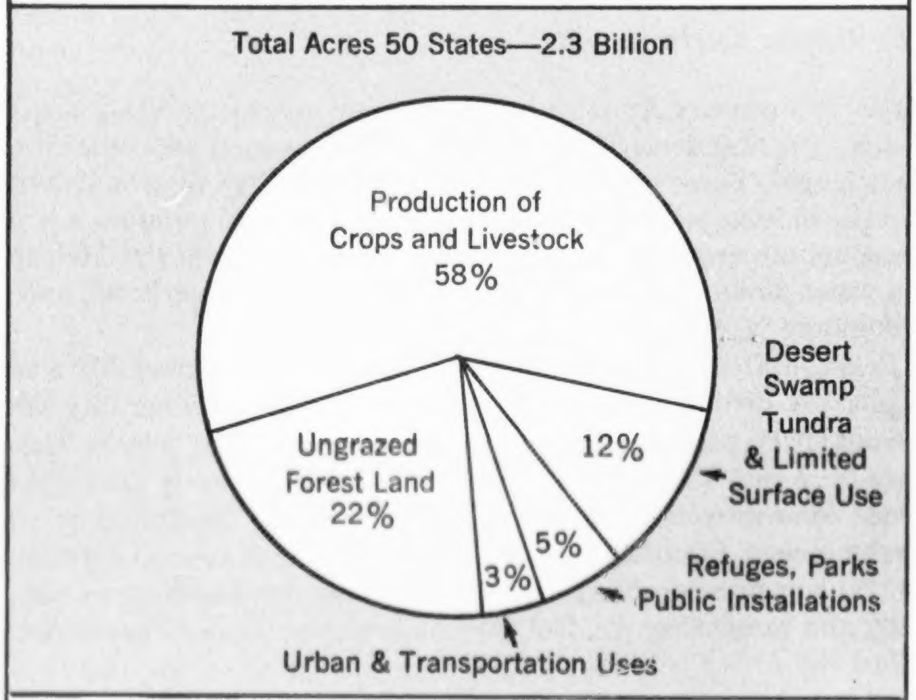
Almost 59 percent of the land is in private hands. Thirty-four percent is owned by the Federal Government. Some 94 percent of all Federal lands lie in the westernmost States—about half in Alaska alone. About 2 percent of the Nation's land is held by Indians. The rest—about 5 percent—is State, city, or county owned.

But land is not just acreage. Land embraces the complex biological systems of the soil and the plants and animals which are all part of a continuing life cycle. Man's understanding of these biological processes, particularly of the permanent damage that begins subtly with piecemeal alterations of the land, is still limited. Yet his dependence upon its stability is enormous.

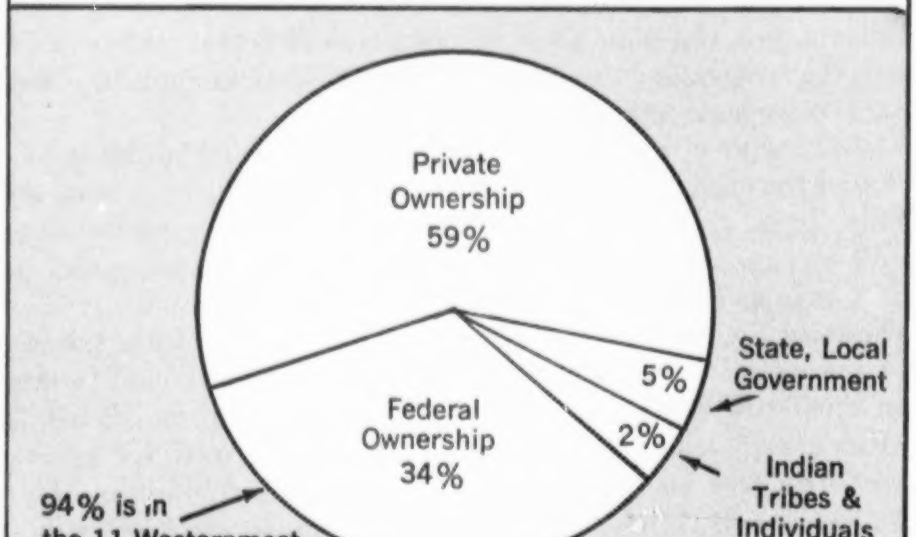
In the Nation's early history, easy availability of land prodded millions to join the massive migrations west and along the major river basins. The wilderness was to be tamed, the trees cleared, and the soil put to crops. Much of the wilderness is now gone, and most of what is left is far distant from the three-quarters of the Nation that lives in the cities and the suburbs. The landscape visible to most Americans is cluttered with traffic, neon signs, powerlines, and sprawl. Flood plains are not just for the river but are subjected to intense development. Open space, the elbow room for urban man, continues to dwindle. Unfortunately, traditions of land use have derived from an assumption that land is a limitless commodity—not a finite biological community.

Government spurs much of this land development by where it locates and how it designs airports and highways, insures home loans, permits filling of wetlands, and lays water and sewer lines. Local governments exercise the primary authority over land use. But effective public influence is hampered by a lack of agreement on objectives, by misplaced economic incentives, and by failure of local governments to harmonize land use.

Land Use in the United States



Land Ownership in the United States



Source: Department of Agriculture.

THE STATUS OF THE LAND

The Urban Environment

Twentieth-century America has known two great population displacements—the first from farms to cities and the second from the cities to the suburbs. Three out of four Americans now live in urban environments—in incorporated settlements of at least 2,500 population and in metropolitan areas consisting of central cities and suburbs. Metropolitan areas alone are home to two of every three Americans, and the percentage is rising.

Residential patterns in many metropolitan areas resemble a series of sharply defined concentric circles. The decaying inner city houses the majority of the urban poor, usually nonwhites who ordinarily have little choice but to stay. Surrounding the inner city are neighborhoods commonly less old and less dense, usually populated by white working-class families. These families often lean toward leaving the central city because of rising property taxes, deteriorating school systems, and racial changes. But they have stayed because they could not afford the newer suburban housing or because of strong ties to their neighborhoods. The 1970 census may show some shifts from this pattern. Beyond the city is suburbia. The suburbs are a magnet for those seeking escape from the burdens of urban life while retaining some of its advantages. (In some areas the pattern is different; the poor often live on the fringes, and the affluent in the city itself, and mixed patterns occur in other metropolitan areas.)

The financial plight of the cities is well known. The influx of the poor and the exodus of the middle class and the wealthy, among other factors, have drained the cities of many of their revenue sources. Public services, such as police protection, park maintenance and sanitation, have deteriorated.

The most visible effects of these economic pressures are the rapid pace and nature of physical change. This is clearly evident in downtown areas where the constant cycle of construction and demolition is often considered a city's badge of growth. Pressed for revenues, many cities bow to the demands of developers to replace historic buildings and distinctive architecture with almost uniform steel and glass box office buildings. Unfortunately, this construction may simply put more people on the sidewalks and more cars on the streets, more monotonous skyscrapers towering above, and more noise and congestion below. Much downtown rebuilding has furthered the trend toward daytime cities with facilities such as offices and banks, which have no nighttime uses. Cities lose their uniqueness as their historic buildings and neighborhoods are replaced by the dullest in modern architecture. The result is often a dreary sameness in the appearance and character of downtown areas.

Physical deterioration is overtaking the housing in many areas of central cities. The oldest housing traditionally filters down to the poorest families as previous occupants better their lot and move to new apartments or suburban homes. Of the 1.7 million substandard housing units in urban areas, nearly all lie in central cities. In slum neighborhoods of some large cities, the amount of abandoned housing is as high as 15 percent.

With the well-known reliance of the suburbanite on the automobile, often to commute to the center city, many downtown and other urban centers have gradually become auto dominated. Much of the change and reconstruction in downtown areas is for freeways, parking garages, and lots—lavish users of space. However, the alternative, public transportation, is constantly frustrated by rising costs, the sprawling nature of the suburbs, and dependence on the automobile.

Many cities have lost the spirit to attract people downtown. With the growing number of shops and other services locating in the suburbs and with crime threatening many local businesses and frightening people from the streets, much of the vitality is missing from the central cities. Many city officials, however, are trying to bring people and excitement back. Apartments in downtown areas, sidewalk cafes, outdoor concerts, bicycle routes, even saving the cable cars in San Francisco—all are small but key efforts to recapture this lost spirit. Rehabilitation, successfully carried out in Philadelphia, and a few other cities signals that the character of the urban environment can be revitalized.

Few cities have kept pace with parkland needs. Trees have not been planted to shade busy avenues at the same rate that they have been felled for street widening. Too often only a few species are planted, and they are often blighted by disease and insect invasions so common to unstable ecosytems. In the Midwest, Dutch elm disease has decimated row on row of beautiful elms.

The immediate economic pressure on a city to permit a parking lot or building on what might remain open space, or to use parklands as part of a freeway route, is often insurmountable. Nevertheless, the accelerating cost of land acquisition and the growing need to preserve open space in a crowded urban environment make the purchase of open areas a sound long-range economic practice, which continues to pay immeasurable dividends. The Boston Common, New York's Central Park, Washington's Rock Creek Park, San Francisco's Golden Gate Park, and many other city parks are tributes to the foresight of early planners in saving large open areas. The protection of streams, ponds, and marshes within cities permits the survival there of numerous species of wildlife, including small animals, birds, and waterfowl which adapt surprisingly well to the urban environment.

Man requires a feeling of permanence to attain a sense of place, importance, and identity. For many persons in the city, the presence of nature is the harmonizing thread in an environment otherwise of man's own making.

The Suburban Environment

Although rural to urban migration was primarily economically motivated, the suburban impulse is largely a matter of social preference. Because of economic and social obstacles, these population shifts have affected the races unequally. Eighty percent of the blacks in metropolitan areas now live in central cities, while 60 percent of the metropolitan whites live in the suburbs. Zoning practices, subdivision controls, and the higher costs of suburban living have made it difficult for lower income minority groups to move from the city to the suburbs.

From 1950 to 1969, while the population of central cities increased only 12 percent, the population of suburban areas soared 91 percent. By 1969, there were 71 million suburbanites and 59 million central city residents.

The suburban tide—Since the late 1800's a blend of town and country has stood for the optimum residential environment. The suburb is thought to offer the best of both worlds. Besides enjoying ready access to the large city with its concentrated economic and cultural facilities, the suburban resident seeks a crime-free neighborhood amid clean air, open lawns, and quiet and uncrowded living. Streetcar and occasional subway lines started what at first was but a trickle of people from the central cities to the outskirts of town. The Federal Government quickened the outward flow after World War II by providing mortgage assistance, which enabled many central city residents to become suburban homeowners. Later the vast urban freeway systems turned the flow into a flood. The automobile now controls suburban life.

To the couple living in an apartment downtown, the birth of a second child is a common signal to abandon the city. And often families with school-age children leave for the better educational systems of the suburbs. As industries convert to modern, single-flow assembly production processes, manufacturers also forego the city for rambling suburban plants. Since World War II, space needs per industrial worker have quadrupled, and three of every four new manufacturing jobs have been created in suburbs.

Each year, expanding urban areas consume an estimated 420,000 acres of land in an undiscriminating outward push. Development moves out from the city along transportation corridors, branching out from the highways and expressway interchanges. Extension of water and sewer services generates whole new developments on quickly divided farms. After outlying areas are built up at moderate densities, developers often return to land which was passed over as undesirable or too costly in the first wave.

Many suburban communities zone to assure that house lots are large and apartment houses few, a practice that assumes that land is abundant. This zoning practice, in seeking to attract moderate to high income families, tends to exclude those in greatest need of the jobs opening in the suburbs. Excluding them deepens the concentration of poverty and unemployment in the central city ghettos.

Highways and freeways become congested as the tide of suburban commuters to the city grows. This congestion, together with the lengthening distances from suburban homes to downtown offices produces tension and robs the typical suburbanite of time with his family.

The impact of growth—Although the impact of the rural-to-suburban shift of land use varies greatly throughout the country, certain effects tend to be common to this change. Open space is continuously eaten up by housing, which, with most present subdivision practices, provides few parks but instead only offers each family its individual front and back yard. Space is likewise diminished by other facilities required by suburban development. Shopping centers and highway interchanges, made necessary by dependence on the automobile and truck, consume large portions of land. Airports, commonly constructed in suburban or exurban areas and constantly growing in size and number, pose similar problems on an even larger scale, attracting a vast conglomeration of light industry and housing. Consequently, the growing suburban population finds less and less public open space.

Building and construction practices, together with the quickened pace of development and complementary zoning, often end in severe abuse of the land and are ultimately costly to the public. The popular practice of stripping subdivisions of all cover before commencing construction destroys tree and plant cover and can trigger heavy soil runoff. Sedimentation from this runoff in urbanizing areas loads nearby streambeds and ultimately river channels. This can cause costly downstream dredging, upstream flood control and destruction of the esthetic quality of lakes and rivers.

Public pressure for flood control projects is often spurred by suburban development along flood plains, which usually contain fertile soil supporting an abundant variety of native plant and animal life. Construction over aquifer recharge areas, where the groundwater is normally replenished, accelerates rapid runoff, increases flooding, and contributes to water shortages.

Suburban development often spreads across ridges and slopes which should be left alone because of their beauty and because their trees and plant cover absorb rain and inhibit flooding. Trees are not only important for their esthetic qualities and as habitat for birds and wildlife, but they affect temperature and air pollution as well. Building on steep slopes can affect soil stability, causing severe erosion which then undermines foundations. Nevertheless, few cities or counties adequately control development of flood plains, steep slopes, or land above aquifer recharge areas. Important data concerning aquifers, subsoil composition, cover, wetlands, and wildlife are not considered by many planning and most zoning boards.

Esthetically, this current pattern of growth triggers at least three adverse consequences. First, much commercial development along roads and highways through suburbs is of cheap and unimaginative construction. Gaudy neon signs, billboards, powerlines, and clutter characterize this development. Second, many residential subdivisions are visually boring—block after block of treeless lawns, uniform setbacks, and repetitious housing designs and street layouts. Finally, wooded streambeds, slopes, and ridges, which could help break the monotony of uniform housing developments, are often destroyed.

The future—Many local governments and developers are learning that careful site planning can forestall abuse of the natural environment and help meet both housing and environmental goals.

The combination of open space with cluster zoning or planned unit development lowers the initial community service costs because of smaller networks of roads and utilities, and it makes a more livable environment for the long term. These developments can vary from new satellite communities like Columbia, Md., to small, sensitively designed clusters of townhouses around a common green. The challenge is to change traditional ways of building and development and to break down the economic and institutional barriers that obstruct widespread use of these innovations.

The Rural Environment

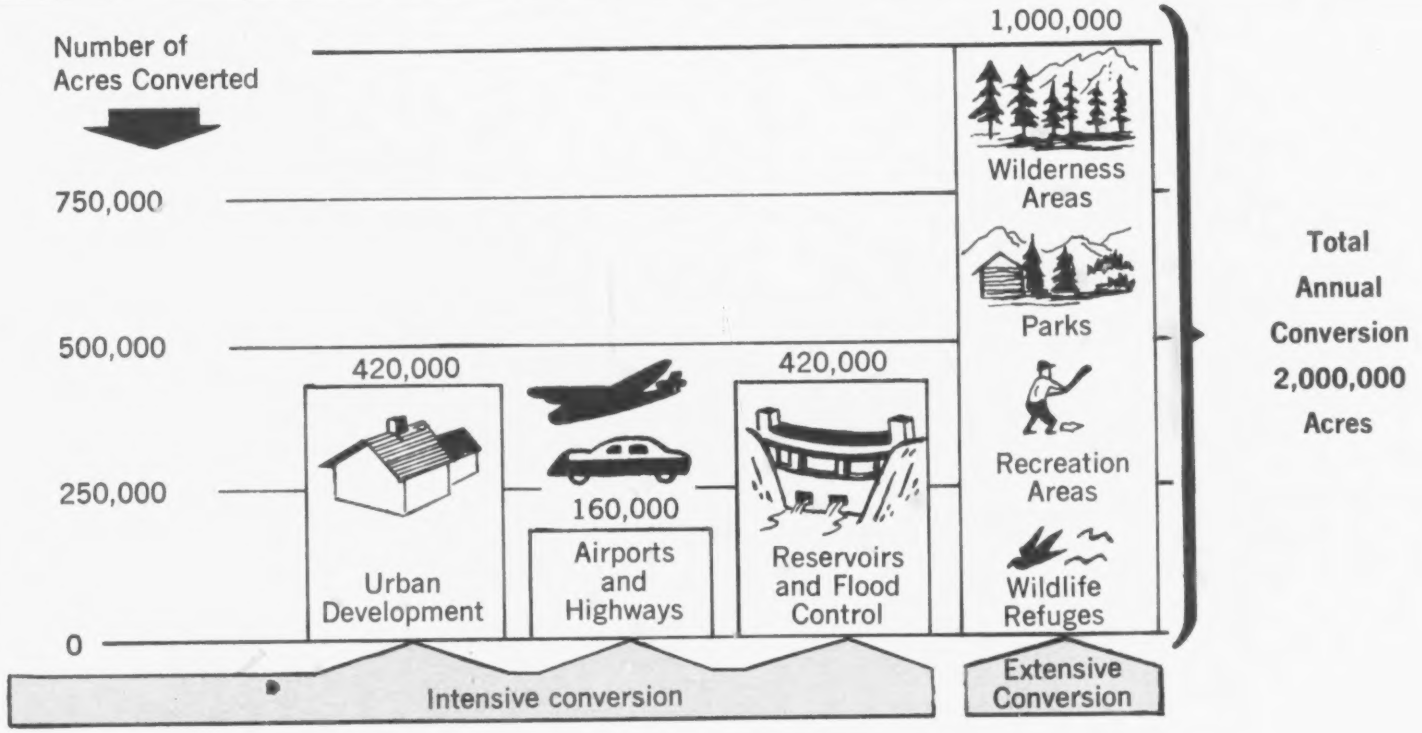
Although polls have consistently uncovered a strong American preference for life in small towns and rural areas, the last few decades have seen a huge exodus to urban centers. About half of the Nation's 3,000 counties, most of them rural, lost population between 1960 and 1970. Of the 53 million Americans living in rural areas, the number living on farms has dropped below 10 million. The remaining 40-odd million rural residents live in villages and towns of less than 2,500 people or on small plots of country land.

Changing rural land use—Statistics on rural land use show conflicting trends. The Department of Agriculture estimates that 2 million acres of land each year, excluding surface mining, are converted to nonagricultural use. Half of this is shifted to such uses as wildlife refuges, recreation areas, and parks. The other 1 million acres are converted to more intensive uses. Of that, 160,000 are covered by highways and airports. An estimated 420,000 acres become reservoirs and flood control projects. The remaining 420,000 acres are developed for urban uses. About half the national acreage converted every year to urban uses is cropland and grassland pasture. The rest is forest and other land.

Food and fiber production by U.S. farmers in 1967 exceeded by 38 percent the 1950 volume. Yet during the same period the number of farms diminished by 2.5 million, and the number of acres harvested declined by a net of 34 million. In 1969, about 334 million acres of land produced all the country's crops for domestic consumption and export. Another 98 million acres of cropland lay idle, in soil improvement crops or in pasture.

From 1944 to 1964, roughly 22.5 million acres were brought into production through private and Government-assisted drainage and irrigation programs. At the same time, in parts of the East not yet urbanized, much of abandoned cropland changed to grassland. It was managed as such for pasture or simply left idle in the first stage

Annual Conversion of Rural Land in the United States to Non-Agricultural Uses



Source: Department of Agriculture.

of natural revegetation. Some of this land now is undergoing or has passed through grass and brush stages to a final forest state.

Effects—The agricultural land use pattern today reflects a highly technical, mechanized, and product-specialized food and fiber industry. It has used the most productive land in the Nation, and it has altered other lands for crop production through vast Government expenditures—often at the expense of marshes, swamps, and bottom lands needed as waterfowl and wildlife habitat. The impact that this highly intensive use of land has on the preservation and diversity of our wildlife and on the integrity of our soils is just beginning to be understood.

Much of the character of farming today is dominated by monoculture, the production of single cash crops. Monoculture has increased production efficiency but has reduced the plant and wildlife diversity essential to a stable ecosystem. These less complex ecosystems are highly susceptible to attack by insects and diseases which can devastate a standing crop or single species regionwide. Moreover, monoculture has forced a heavy dependence on pesticides and fertilizers.

Farmland near cities is increasingly disappearing into suburban development. The scenery of diversified rural landscapes—with their fields and hedgerows and woodlots—is an important esthetic resource, particularly to urban populations. Although not entirely comparable, much of the charm and beauty of European countrysides derives from such landscapes. Unfortunately, insufficient effort has been made to keep the most attractive rural lands near cities from being consumed in the massive conversion to urban life.

The Coastal Environment

In the land and water areas of the American coasts lie some of the most fertile parts of the environment. The coastal zones, which include beaches, estuaries, tidal flats, bays, marshlands, lagoons, and sounds, with their adjacent lands, comprise areas of great biological diversity and productivity. The coastal zone includes urban, suburban, rural, and natural areas and faces all the problems of each. It is, however, a unique system which has important national significance and is subject to intense and conflicting manmade pressures.

Its surface is relatively small—only 15 percent of the U.S. land area. But 33 percent of the Nation's people are concentrated on the coasts, four-fifths of them in urban areas. While the national population increased 46 percent from 1930 to 1960, the population in coastal counties increased by 78 percent.

Life at the edge—Because of the natural mixing of fresh and salt waters, the estuarine environment produces a wide variety of living organisms, from microscopic species to large numbers of fish and shellfish, birds, and mammals. Many species, such as clams and oysters, spend their entire life cycles in the estuaries. Others, particularly shrimp, migrate from the sea to estuarine nursery areas. In these rich waters, they grow to sub-adult size before returning to the sea to complete their life cycles. The anadromous species, such as salmon and striped bass, pass through the estuaries to their spawning grounds farther upstream, and the young return through the estuaries to the ocean. At least two-thirds of the animal populations in the oceans spend an essential portion of their life cycle in estuarine waters or are dependent on species that do. Innumerable waterfowl and shorebirds depend on the plant and animal organisms of the coastal zone for their food. Many winter and nest in these waters.

The base for all animal life in estuaries is the abundant variety of plant growth, from mangroves to eelgrass and algae. They are supported by the mixing and flushing action of the tides and the organic nutrients which collect to produce the rich bottoms and wetlands. While estuarine zones are physically varied, they all share the slow mixing action of the seaward flow of fresh water with the landward tides of the sea. Because of the concentration of people within the coastal zone, the estuaries receive large volumes of all kinds of waste, which are thereby trapped and concentrated. When estuarine waters are polluted, vast numbers of important fish and shellfish are affected as well as the numerous birds, reptiles, and other wildlife which are part of this food chain.

The conflicts—Competition for the use of the limited coastal zone is intense. Shipping activities are increasing, with larger vessels needing deeper channels. Mining and oil drilling in coastal waters grows daily. Urban areas expanding throughout the coastal zone continue to enlarge their influence over these waters. Industrial and residential developments compete to fill wetlands for building sites. Airport and highway construction follows and further directs growth patterns in the coastal zone. Recreation—from enjoyment of the surf and beaches to fishing, hunting, and pleasure boating—becomes more congested as available areas diminish. Since over 90 percent of U.S. fishery yields come from coastal waters, the dependence of the commercial fisheries industry on a stable estuarine system is obvious.

Although some uses of coastal areas are undoubtedly necessary, many are not. Much industry, housing, and transportation could be sited elsewhere.

Dredging and filling—Besides water pollution, the major adverse effect on the coastal lands and waters stems from physical alteration of submerged and adjacent land and habitat—particularly the shallow marshes and wetlands. The major alterations of wet and submerged coastal lands comes from draining, dredging, and filling. Cumulatively these actions can entail the disappearance of the essential food base for practically all organisms in these waters.

The consequences of dredging and filling, because they often represent a series of incremental activities, do not usually become apparent until much of the permanent damage is done. Some 2 million to 3 million waterfowl used to nest and feed in San Francisco Bay before a large part of it was gradually filled. Their numbers are now down to less than 600,000. The State of California, with support from citizens and communities in the Bay area, has now formed the Bay Conservation and Development Commission to provide regional control over that irreplaceable estuary.

To the developer with little appreciation of the biological importance of estuaries, wetlands represent attractive waterfront acreage in particular demand by industrial and commercial concerns and home buyers. Relatively inexpensive to dredge, fill, and bulkhead for building sites, shallow wetlands attract many industries which are not dependent on waterfront sites but which find an economic advantage in developing these low-priced lands. Too often local governments acquiesce, anticipating the increased tax revenues. Consequently, natural coastal areas are being nibbled away. The long-range economic and ecological costs of this process are borne not just by the particular local community but by the people of the State and the region, and no less by the rest of the Nation.

The vacation industry—A growing part of the development pattern spreading throughout the coastal zone is the growth of vacation homes. The Department of the Interior has estimated that over 68 percent of the total recreational property values along the coasts and Great Lakes are accounted for by shorefront homes. They occupy over 90 percent of the recreational lands on developed coasts.

Only 6 percent of the land that can be classed as recreation shoreline is in public ownership, and not all of that is accessible to the public, particularly the many miles of Department of Defense holdings.

Management—Ownership of the wetlands in many States is a confusing tangle of State, local, and private claims, and in some coastal States valuable State-owned wetlands have been transferred to private interests for the specific purpose of development. Likewise, restrictions on development of the contiguous lands and wetlands are, with some exceptions, inadequate. Only a few States, notably Massachusetts, Connecticut, and North Carolina, have wetlands protection laws which require permits or other controls before alterations can be made to private coastal lands. Even fewer States have exercised any statewide powers over the contiguous dry lands. Hawaii, Wisconsin, and to some extent, Oregon, are among the exceptions.

The most important Federal permit authority affecting coastal zones is held by the Army Corps of Engineers. Dredging, filling, and all other structural changes in navigable waters require Corps permits under the Rivers and Harbors Act of 1899. The Fish and Wildlife Coordination Act and an interagency agreement also provide for review of all Corps permit applications by the Department of the Interior and State fish and game agencies. Their role is to review fish and wildlife, water pollution, recreation, and other environmental considerations. The National Environmental Policy Act of 1969 bolstered the authority of the Corps to consider all environmental aspects of a particular permit application. And the Water Quality Improvement Act of 1970, as a condition to granting permits, now requires State certification that the particular activity will not violate State water quality standards.

The Administration has recommended legislation to Congress to assist the Great Lakes and coastal State governments to manage and protect their coastal resources. The proposed legislation seeks to encourage these States, in cooperation with local units of government, to prepare and implement comprehensive land use plans for their coastal zones. To be eligible for Federal grants, the States would be required to assume regulatory and eminent domain powers. At a minimum, this would assure that local zoning actions would comply with statewide plans. Further, public notice, public hearings, and review of all Federal and federally assisted State and local projects would be conditions of grant eligibility.

The Natural Environment

Natural plant and animal communities—besides satisfying man's yearnings for beauty and recreation—perform indispensable roles in his welfare. Wild areas are part of man's past and essential to his future. The biological rhythms of modern man, which shape his life, are often tied to the natural forces beyond his urban surroundings. And yet wild areas are not fully free from man's influence. Some—for instance, where man is present for short periods and leaves hardly a trace—are little influenced. Others—lands actively mined, logged, or grazed—are heavily influenced.

For many years, the American people have realized that the most unique and spectacular of these natural areas should be protected and saved by Government.

The Federal lands--Management of most Federal natural lands falls under four agencies:

	Million acres
Department of the Interior:	
Bureau of Land Management	470.4
Fish and Wildlife Service	30.5
National Park Service	27.1
Department of Agriculture: Forest Service	186.9

Many other forests, parks, and recreation and conservation areas have also been set aside by State and local governments and by citizens' groups with an interest in the natural environment.

Their management varies from protective preservation to multiple use. Most of the Federal lands are managed to combine outdoor recreation, range, timber, watershed, and fish and wildlife uses. Many of the management programs permit the extraction of oil, gas, and other minerals; others aim primarily at esthetic values. Although Federal land management is meant to maximize public benefit and not to reflect only economic gain, land management agencies have been criticized for policies that overemphasize developmental values.

As other natural areas are staked out for intensive resource development, they are bound to come into even more serious conflict with preservation and recreational interests. Statutory resolution of many of these potential conflicts may be necessary, as may administrative reforms by the Executive Branch. The report of the Public Land Law Review Commission will serve as a focus for the debates that will shape such changes. The report has just been published at the time of this writing; consequently, a review of its findings and recommendations is not attempted here.

Federal lands managed primarily for the protection of their natural characteristics and the preservation of their fish and wildlife can take only so much use by man. Allowing people to enter these areas in large numbers must be weighed against their impact on the region's ecology. Protected areas must be managed so that constraints are placed on certain uses, including recreational uses requiring motorized transport.

The wilderness system—Some large areas under Federal control are expressly set aside as wilderness. The Wilderness Act of 1964 already protects approximately 10 million acres, although less than one percent of this is east of the Mississippi River. The Wilderness Act requires the Secretaries of Agriculture and the Interior to submit plans to Congress for including in the National Wilderness Preservation System additional natural areas having substantial wilderness qualities and presentlymanaged by the Forest Service, the National Park Service, and the Fish and Wildlife Service. These areas are to be of sufficient size, permanently roadless, and without commercial development.

Delays in setting aside wilderness areas, especially those within national parks, have stirred a public controversy. Sixty Forest Service areas have already been designated by Congress in accordance with a 10-year plan to have all wilderness areas set aside by 1974. But not a single National Park area and only one small area in a National Wildlife Refuge have been officially designated. The process of designating wilderness areas requires surveys and master planning by the lead agency, followed by public hearings, before the proposals go to Congress. Conservation groups have complained that the Federal agencies are not adequately staffed to complete the planning and hearing procedures. Conservation leaders also have criticized Forest Service and Park Service proposals for not including some additional areas with outstanding wilderness qualities in their recommendations for Wilderness Act protection.

Scattered throughout the Federal lands under various agencies are 336 "research natural areas"—a specific classification for lands left undisturbed for purposes of research and education. A number of ecosystems, however, such as the tall grass prairie of the Central Lowlands, are sparsely represented or are not included at all. Plans are now under consideration to add approximately 300 areas so that all major ecosystems will be represented.

Acquisition of natural areas—The major source of funds to purchase most Federal natural areas is the Land and Water Conservation Fund. Revenues for it come primarily from a tax on motorboat fuel, sale of surplus Federal property, Treasury appropriations, user fees from Federal recreation areas, and—to bring the total to $200 million each year—Outer Continental Shelf mineral receipts. For the first time, the full authorization of $200 million is being requested by the President for appropriation in fiscal year 1971. The President has also asked that the unappropriated balance from past years be tapped to increase funding for 1971 to $327 million, compared to $124 million in the 1970 budget. Finally, the Administration has recommended raising the $200 million annual authorization of the Fund to $300 million. This would take effect in fiscal year 1972.

Over half the allotment from the Fund this year will go to the States and through the States to local governments. These funds are matched dollar-for-dollar by the States for the planning, acquisition, and development of outdoor recreation areas. The remaining funds are budgeted for land acquisition by the Federal Government to the National Park Service, the Forest Service, and the Bureau of Sport Fisheries and Wildlife (for rare and endangered species' habitat and for recreation lands adjacent to wildlife refuges). Major recent Federal purchases have been made from the Fund, notably the Redwood National Park in California and land within the national seashores. The new funding requested by the Administration will permit the Government to consolidate and protect many other important natural areas, including Point Reyes National Seashore in California.

The Migratory Bird Conservation Act of 1929 authorizes the Government to purchase additions to the 30-million acre National Wildlife Refuge System. Funds for this come mostly from the Migratory Bird Hunting Stamp Act of 1934, which requires all waterfowl hunters to purchase a Federal hunting stamp. Although about 25 million acres in the present 328-unit system are Federal lands which were withdrawn for refuge purposes, most of the national wildlife refuges acquired in the past 15 years have been bought with funds from sale of these "duckstamps."

Crowding—Natural areas under the direction of the National Park Service have become immensely popular with the millions who visit them each year. Yet the enjoyment diminishes as the number of tourists rises. Some of the more popular natural areas in our parklands have become clogged with traffic, noise, litter, smog, and most of the other elements of our technological society from which the visitors are trying to escape.

Identifying the best mix of uses for natural areas is difficult because scales for measuring esthetic value and natural phenomena are elusive. In the future, limits on use may have to be set at crowded parks or in ecologically fragile areas. California has attempted a system of advance reservations in some of its crowded camping areas in State parks. Some national parks may soon follow suit. Control of auto traffic will be forced upon many areas to preserve the values that the park or forest seeks to maintain. Alternative modes of transportation may be necessary. Yosemite National Park, long threatened by overcrowding, has excluded cars from the eastern part of the valley and converted other roads to one-way traffic. Where traffic is prohibited, access is provided by small buses. As Americans are more frequently attracted by their natural heritage to places where they can know nature firsthand, controls of these kinds will become more common.

Exploitation—Timber is cut and sold from the national forests, and to a lesser extent, from lands administered by the Bureau of Land Management. This use is a growing one. Cattle and sheep are permitted to graze on approximately 273 million acres of Federal land. Mineral leasing, mostly oil and gas, now uses over 64 million acres. Most of the public lands are open for recreation in one form or another. Across all these lands are spread diverse habitats which support varied species of wildlife.

Overgrazing, widely practiced during the latter part of the 19th and early parts of the 20th century—and still a problem today—has dramatically affected these lands. The semiarid and arid climate of the West has added to the destruction. Dry years have usually coincided with falling market prices. And when that has happened, cattle and sheep ranchers short of cash have often overstocked already depleted ranges. Much of this land, particularly the vast public domain, remains today in desperate condition, as wind, rain, and drought have swept over them and eroded their exposed soils. Although the effects of overgrazing in rich pastures or prairie farmland can be quickly corrected, the process is often irreversible on the limited soils and arid climate of much of the public lands.

What overgrazing does to the soils and habitat of the vast range lands, poor lumbering practices do to the forests. Mismanagement of timber cutting, in addition to being an eyesore, can also damage natural systems far beyond the forests. Debris and erosion of the limited soils of the forested West often choke streambeds far downstream. The tendency toward monoculture for the benefit of lumber and pulp has its environmental results. Not the least of these is the loss of many native species. The greatest loss of timber is not from fire and disease but from insects, which can devastate large forests of single species. Widespread application of insecticides often follows.

Wildlife—Ultimately these and other uses of the Federal lands fall most harshly upon things wild and free, for protecting and improving habitat is the key to saving wild species.

Wildlife protection in the United States today paints a complex picture. The populations of most game species are high, and their status constantly improves, particularly deer, elk, and various game birds. However, until recently, nongame species of wildlife have been largely ignored and their condition is less well known.

Wildlife in the United States has long been equated with "game" and most public attention, research and management efforts have been directed towards species of sport value. However, trends indicate that persons wanting only to observe wildlife are likely in the future to outnumber hunters. Unfortunately, this change in public attitude has not yet been reflected in increased funds for nongame species. In 1969, total funding from all sources—Federal, State, and private—aimed at wildlife research, management, and habitat protection was about $142 million. Only $6 million of that was clearly related to nongame species.

Nevertheless, sportsmen in this country have contributed impressively to wildlife preservation through the Government use of duck stamp revenues, and tax revenues on sporting arms and ammunition to heavily support State fish and game agencies. Numerous outdoor organizations have also helped conserve land and teach wildlife conservation to their members and the public.

As a group, the large predators stand in greatest danger of extinction. The belief that most predators should be exterminated was central to the early days of ranching and wildlife management. In some areas this unfortunate belief endures. There are still strong pressures on State and Federal wildlife agencies to continue predator control programs for certain bird and mammal species, despite their diminishing numbers and their importance in making room for young, vigorous animals by killing off the old, the weak, and the sick. Nonetheless, most States are making progress in providing legislative protection for the large predators. Some notable exceptions are Arizona, where mountain lion hunting is not controlled, and Alaska, where bounties are still paid for wolves.

Threatened species are getting more attention at Federal and State levels, but limited funds still restrict effective management and research. The new Endangered Species Act should strengthen control over marketing illegally obtained species. It also will place the United States in a better position to cooperate with other governments in the protection of their threatened wildlife. Its effect is already visible in the diminished poaching of alligators in the Everglades. Their numbers have increased because of it.

The emphasis here is on wildlife. Fish are dealt with in the water pollution chapter and in the foregoing section on the coastal zone. Unfortunately, the status of fish and shellfish species is less known than that of terrestrial wildlife.

Epilog—These pages have tended to emphasize the worst effects of grazing, lumbering, recreation, and other uses. The point is that many uses can be compatible and often are. Many modern timber practices can improve forest conditions, and increasing numbers of stockmen are sensitive to range conditions. It is the excess, promoted by overemphasis of the short-term economic gain, which needs curbing. The lesson of man, of land, and of wild things is hard to learn. Aldo Leopold put it well: "A land ethic of course cannot prevent the alteration, management, and use of these resources, but it does affirm their right to continued existence, and at least in spots, their continued existence in a natural state."

THE INFLUENCE OF GOVERNMENT

As the Nation has grown, so have the number of local agencies empowered to decide how land is used. But because of their limited geographic scope, they cannot provide anything resembling a land use system. The narrow authority of each permits it to ignore what the decisions of all will do to the natural and human systems regionwide.

Land Use Controls

Public officials can now call upon a growing inventory of sophisticated land use tools at local, regional, and State levels. But often these devices are little used, and seldom in a way that rationally shapes or directs development.

A wise mix of land use techniques and powers can often balance private economic interest and public benefit. However, the relative importance of particular devices depends on the degree and nature of the control desired at a specific time in a given community.

Conflicts among the rights of an individual landowner, his neighbors, and the community should be resolved by the unit of government best able to take into account broad regional interests. Urban growth has outstripped the ability of small government units to handle environmental decisions that have metropolitan, regional, or even statewide impact. To offset this, many State governments have begun taking back some of the land use powers that they had delegated to municipalities. Although it has been long in coming, Americans are recognizing the need to examine carefully what government can do to assure that land is treated as a resource to be managed and not merely as a commodity to be marketed.

The police power—This term covers a wide array of land use devices designed to protect the welfare of the general public. They limit the free use of property rights in return for protecting the general community. All exercises of the police power have a common characteristic—they are subject to easy change. This is a disadvantage of the power as a land use tool—although flexible, its exercise may be only temporary.

Zoning—Zoning is the major police power employed to control land use. It classifies and segregates the land according to the permitted uses. It can curb those uses up to the point of taking private property without compensation. Within each classification, zoning can set limits on the nature, extent, and improvement of land. Although it has worked in well-established communities where there is little land speculation or pressure for new commercial facilities, it has had less success preserving open space or channeling growth in developing areas. While ideally zoning should implement sound land use plans, it does not necessarily do so. It is usually honored in the breach by the granting of variances or amendments once the pressure of development is on.

The close relationship between the land developers and members of zoning boards in many jurisdictions often jades public confidence in zoning as a tool for sensitive land planning.

In many suburbs zoning has become a device to exclude less desirable residential, commercial, and industrial newcomers. In such communities, it is used primarily to discourage the kind of development that will cost more in municipal spending than it will pay in property taxes. This often means that apartment houses which accommodate large families, public housing, and even one-family homes on small lots are outlawed because they raise the tab for schools, parks, and other public facilities without bringing in commensurate revenues. Zoning accomplishes this by limiting construction to single family homes on large lots with large side yards and setbacks.

Subdivision controls—Subdivision controls embody some of the most promising tools for regulating urban growth. They comprise all the local ordinances and regulations that tell the landowner what he can and cannot do in dividing his land into lots and selling them or developing them. Where controls are used solely to benefit the developer economically, they can lead to tedious and unattractive developments with uniform setback and lot size, unimaginative street patterns, and little provision for open space or for commercial facilities within walking distance of homes. On the other hand, when subdivision controls permit cluster development, open space preservation, planned unit development, and other imaginative innovations, they can bring a sense of community and vitality. The flexibility of subdivision controls allows increased sophistication in the development of urban and suburban areas. For example, by the proper use of timed development, a community places all of its expenditures for new public utilities and services in one geographic area at a time, allowing for ordered growth at lowest public cost.

Sewer and water permits—Before water and sewer service may be extended to new housing and other facilities, most communities require certification that public capacities are adequate to supply the services and that equipment and other facilities on the property meet local specifications. When combined with adequate control over the use of wells and septic tanks, these permits can dictate the pace and direction of urban growth. Nevertheless, sewer and water lines today more often are installed in response to already uncoordinated and poorly thought-out development.

Suburban and regional shortsightedness has left some towns with inadequate water supplies and sewage treatment facilities for new residential, commercial, and industrial growth. Because of stricter enforcement of water quality standards, it has been necessary for regional and State authorities to prohibit further sewer hookups in large parts of several metropolitan areas, including Washington, D.C., Cleveland, and the northern New Jersey urban region. The disruptive conditions which led to these recent decisions dramatize the need for proper land use planning techniques to assure a predictable rate and direction of growth and development and to prevent economic hardship for builders, businessmen, industrial concerns, and homebuyers.

Eminent domain—Eminent domain gives to government the right to acquire lands. It is an outgrowth of the old English common law principle that the Crown held ultimate power to buy any lands in the realm and, the landholder unwilling, to seize them and pay compensation. The right of eminent domain in this country likewise may be invoked in the case of a reluctant seller, provided the property is used for the public benefit and there is just compensation. Urban renewal and highway construction projects have used eminent domain to purchase vast numbers of properties. But eminent domain is also available for smaller public benefits—such as purchasing an easement for access to a public beach or preserving an historic building.

Land purchase or acquisition of limited land rights by a public body is, in theory, an effective way to control urban sprawl. But so far, little of this has been done, either to assemble large parcels for proper development or to preserve open spaces. For financial and political reasons, local governments in rural areas have not acted while prices are still low and unaffected by urban pressure. Once an area starts urbanizing, local governments are unwilling and often unable to pay the inflated land prices. By that time, it is also too late to purchase limited rights, such as scenic easements to preserve the land, because they often cost nearly as much as full purchase.

The planning function—Comprehensive urban planning is a commitment by government to help foresee and direct growth and change within its borders. With it development decisions can be made more knowledgeably. Planning is a natural extension of the traditional goals of police power and eminent domain power to promote public welfare. When planning determinations affect private property, they require the same standards of reasonableness and fairness to the owner.

Planning has often been misunderstood. The public often fails to understand that a comprehensive plan is a living, changing mechanism and not a static set of maps. Many citizens believe that the planning process has ended when the municipality approves a master plan. The long period of time required to prepare land use, public facilities, and transportation plans for large metropolitan regions has caused many citizens to regard planning as an academic exercise. Often this feeling is only strengthened by those planners who ignore the opinions of local residents. However, growing numbers of cities, metropolitan areas, and regions adhere to and implement their plans. As planners begin to take greater cognizance of public attitudes, the value of planning as a predictive and directive tool may be better understood.

Planning has been criticized because it has often been unable to influence important land use decisions. This is not necessarily the fault of the planning process, although in many communities the planning organization is often pressured to conform its plan to unwise developments. It may be due instead to inadequate institutional arrangements that have been made to implement the plan. In many localities, the planning bodies are distinct from the action agencies. Consequently, the planning function becomes little more than advisory, and the planning office spends inordinate time and resources inside city hall lobbying the departments possessing the large budgets and the authority.

Finally, planning efforts to direct all development forces in a rational manner are often inadequate. What should be "comprehensive" sometimes deteriorates into a complementary set of specific functional planning goals for transportation, open space, schools, or some other single goal. In the process perspective is lost. Economic growth and efficiency become design criteria. Environmental aspects are often neglected for short-term economic gain. Planning that is not comprehensive and long range cannot hope to evaluate ecological factors properly.

The role of private agreements—Covenants, conditions, easements, and like restrictions on property use comprise a special set of land use devices which traditionally have been employed by neighboring property owners. Recently they have also been invoked by government and private groups to protect land. For example, citizens of several towns in Massachusetts have executed agreements with local conservation trusts, funded in part by the towns, to protect their wetlands from further development. Covenants, conditions, and easements can be tailored to carry out specific purposes. They are well established in the law and continue in their effect even if the property is sold.

Permits—The Federal and sometimes State Governments require permits for a range of activities on land and submerged lands. Although the control of individual land use decisions regarding private land is primarily local and varies widely, these permits may influence major growth patterns and economic development.

Federal permits are issued when public lands are involved. Leases, use permits, and licenses are granted to extract oil, gas, coal, and certain other minerals, and for grazing, recreation, and timbering. These permits affect not only the public lands, but also may influence the use of nearby privately owned land.

The permit authority of the Army Corps of Engineers is a significant tool in land use decisions affecting navigable waters in the United States. These permits are discussed in this chapter in the section on the coastal environment. Some States have enacted legislation requiring permits for alteration of wetlands, bottomlands, and in some cases adjacent land areas. The trend is toward stronger State controls on dredging, draining, and filling of coastal areas.

Tax Policy

Tax policy is a vital cog in deciding income and profit for land investors, suburban developers, urban developers, and landlords—the big influencers of land use. Taxation therefore is an essential tool in shaping the manmade environment and preserving the natural environment.

Local property tax—A major cause of the decline of services in some core cities is the loss of actual and potential tax revenue when residential, commercial, and industrial development spreads to the suburbs. With strict zoning and subdivision controls, many suburban communities exclude all but those who will add more to the tax rolls than they will require in municipal expenditures. Rather than finance government activity for the benefit of all people in an interrelated urban complex, the property tax has abetted local isolation from regional land use problems.

Assessment procedures have improved in many municipalities, but more reform is necessary for a fair spread of the tax burden. At present, land in urban areas tends to be undervalued and the improvements on land overvalued for tax purposes. Consequently landowners in urban areas are discourged from restoring structurally sound buildings or replacing deteriorated ones with new structures, since such improvements will raise the taxes disproportionately. On the developing fringe of urban areas, low taxes on raw land have encouraged speculative purchase and leapfrog development.

As mentioned earlier, an increasingly serious problem in city cores is property abandonment. There are delinquent taxes on some of these vacant lots and buildings, but little is done to collect them. Even less often are such properties confiscated by the city and turned to public use or sold to redevelopers.

The threatened loss of the tax base in urban areas has forced some cities to offer concessions to keep industries from moving to the suburbs, often including failure to enforce air and water pollution standards and other controls of industrial activities damaging to the environment.

Finally, few communities have constructively exploited the interrelationships of zoning, subdivision controls, and other land use devices with property tax policy. The local property tax could be a useful device, particularly in encouraging cluster development and open space preservation where no such options exist. Special tax treatment for commonly owned open space and community facilities also encourages protection or enhancement of the environment by subdivision developers.

The Federal income tax—Some aspects of the Federal income tax deliberately encourage specific types of land development. Other aspects cause inadvertent effects. The Council, with the aid of its task force on tax policy, has undertaken to examine many of the leveled criticisms. Some are outlined below.

An important land use impact of the Federal income tax stems from the deductibility of local property taxes. The intent of this provision is to relieve the homeowner from paying a tax on a tax. Often, however, major benefactors of the deduction are slum landlords and land speculators. The latter are said to be relieved by this provision from the burden of local taxation as pressures of urbanization increase the value of their holdings.

Although tightened by the Tax Reform Act of 1969, depreciation provisions of Federal income tax laws are still in need of study to determine whether they adversely affect land use decisions. Accelerated depreciation and redepreciation of buildings may foster high numbers of substandard rental housing units in core cities. Such provisions have encouraged ownership of rental property for a limited number of years, then a selloff rather than improvement of the property. These so-called fast writeoffs encourage poor quality construction in new rental units since the first owner seldom plans to own the property more than a few years.

Tax laws benefit the homeowner by allowing him to deduct mortgage interest. But they do not permit rent payments to be deducted. Much has been done recently to determine to what extent present living and land ownership patterns of the slums, the central city, and the suburbs are traceable to these tax policies.

There is growing interest by private citizens in preserving forest and woodland, protecting additional animal and fish habitat, and preventing further deterioration of their own and nearby landscapes. Some landholders have sold or donated development and other rights on their land to public bodies or private conservation groups for permanent preservation. Recent Internal Revenue Service rulings have attempted to establish the value of these gifts in light of general tax rules by basing it on the fair market value of the land as restricted compared to its value previously. Some have argued that greater certainty and more liberal treatment should be provided in establishing the value of what was given in order to encourage conservation easements and similar devices for environmental protection.

The Impact of Federal Activities

A myriad of Federal loans, grants, projects, and other programs enacted for specific public purposes often has direct impact on the use of land. Because of the interrelationships of these programs with those of other levels of government and the private sector, it is difficult to assess the degree of Federal influence. The most significant Federal activities include the highway, airport, and mass transit programs, the sewer and water grant programs, home mortgage assistance, open space funding, agriculture subsidies, planning assistance, the location of major Federal facilities, and water resource projects. A brief discussion of these programs and their land use consequences is included in the Addendum following the section "What Needs to be Done."

WHAT NEEDS TO BE DONE

Land use influences, trends, practices, and controls in the United States are complex. While by no means an exhaustive survey of all the environmental problems that are land related, the above summary does indicate the need for developing standards to evaluate what is happening to this basic resource and to develop policies that will guarantee its continued integrity. In short, there is a need to begin shaping a national land use policy.

The reforms in Government activity needed to institute a national land use policy are undeveloped at this time. It will be necessary first to determine which levels of government must assume which specific responsibilities and to identify the appropriate mechanism at each level to achieve such a policy. However, this chapter has identified certain aspects of a strategy which the Council feels merit special consideration:

- The Federal Government should encourage, through project approval under existing programs, widespread use of devices such as cluster zoning and timed development.
- Although a number of Federal programs exist to preserve buildings and neighborhoods of architectural quality and historical significance, there is a need for increased attention and a comprehensive strategy if significant progress is to be achieved.
- Comprehensive metropolitan planning should identify flood plains, wetlands, aquifer recharge areas, unstable surface and subsurface characteristics, and areas of value for scenic, wildlife, and recreational purposes. Development in these areas should be controlled.
- Federal grants for sewer and water projects and open space acquisition should be directed toward communities or project areas which will use them to control development rather than to those which merely respond to uncontrolled growth.
- Home mortgage and interest subsidy programs should be used to encourage the proper siting and environmental compatibility of the subdivisions in which new housing is constructed.
- Congress should act to reverse the degradation of the coastal zones by enacting the Administration's recommended legislation, S. 3183 and H.R. 14845.
- National wilderness areas should be designated as quickly as possible; the appropriate Federal agencies should comply with the intent of the Wilderness Act even if substantial temporary reassignment of personnel is required.
- The National Park Service should accelerate its control systems experiments to prevent overcrowding and traffic congestion in the National Parks.
- Greater emphasis should be given through existing programs to acquire small parks and natural areas near cities.
- Additional areas of special ecological significance should be protected, and the Federal Government should identify and establish a national registry for research natural areas.

Addendum

THE LAND USE IMPACT OF FEDERAL ACTIVITIES

Major Federal Installations

The Federal Government is responsible for constructing installations throughout the country for research, national defense, and other purposes. The largest such facilities are frequently placed in remote areas where the impact on surrounding natural values can be severe. Until recently little was done to assure full consideration of these impacts, particularly as they relate to the environment.

The construction of facilities by NASA at Cape Kennedy, Fla., is a case in point. The massive needs of this complex for men and materiel brought an entire county of Florida under severe development pressures. Brevard County was engulfed overnight by residential subdivisions, commercial strips, and highway corridors. Large areas were cleared of vegetation, wetlands were filled, and stream systems were altered. Recent cutbacks in space exploration have brought the county quickly from boom to economic decline, contrasting the short-term economic benefits with the long-range ecological costs resulting from development, federally encouraged or otherwise, without adequate planning and control.

Equally important are the large Federal properties, mostly Department of Defense holdings, in and near urban areas which are being underutilized by Federal agencies. The President has ordered a survey of all such Federal real property. The aim is to identify those lands which could be better used, especially for public recreation.

Water Control Projects

The Federal Government also spends heavily on resource development. Every year as much land in the United States is converted to reservoirs and flood control use as for urban and suburban development. Most of the development is undertaken by four Federal agencies with responsibilities for water resources. The Army Corps of Engineers, with an annual development budget of $1.36 billion, is active throughout the Nation with heavy emphasis on flood control and navigation improvement projects. The Bureau of Reclamation of the Department of the Interior, with its $300 million budget, operates in 13 Western States developing irrigation and municipal and industrial water supply and electric power. The Tennessee Valley Authority spends $10 million a year on multipurpose water resource projects, with the emphasis on flood control, water quality control, recreation, and economic development. The Soil Conservation Service of the Department of Agriculture spends approximately $100 million annually on its small watershed and flood prevention programs.

The primary rationale for these vast Federal outlays is to supply water for agricultural, industrial, and domestic use and to prevent floods. However, the environmental implication argues for a reevaluation of certain programs. Although the concern has been to produce water for growth and expansion, the decline of the quality of the natural and human habitat, which too often results from such projects, requires a broader perspective. Alternatives are now more seriously considered, along with the potential loss of environmental values. When the public outcry has been strongest, it has prevented the inundation of beautiful stream valleys and canyons.

But understanding of the proper balance of water resources and environmental needs is only in its infancy. The number of free-flowing streams and rivers declines yearly as new dams, canals, or channels impound and divert the waters. Although extensive recreation areas are often created from such projects, they often irreversibly destroy the natural systems of land and water in addition to recreation uses of free-flowing streams and rivers. While millions of fertile acres are being abandoned in some areas, millions of dollars are spent in others to irrigate deserts and to dike wetlands for farming. Although some shifts in agricultural land use are clearly necessary, there is no coherent policy to assure that environmentally damaging projects are kept to a minimum. We continue to develop flood plains, then spend millions to protect man's use of them from natural flooding cycles. We continue to view the provision of water resources as a challenge to our engineering ability rather than as a challenge to weigh against man's ecological obligations.

Aids to Other Government Bodies

Although major Federal grant programs to State, regional, and local governments require compliance with numerous criteria, the criteria are rarely environmental. Stronger enforcement of the procedures outlined in Section 204 of the Demonstration Cities and Metropolitan Development Act of 1966 and greater consideration of environmental planning criteria are logical first steps toward developing a national land use policy.

Highways—Aid to States for highway construction is a major Federal outlay. The Federal authorization for fiscal year 1971 will total $5.4 billion. Four billion dollars is for work on routes of the interstate system. Seventy percent of this 42,500-mile network of high-speed, limited-access highways was complete as of January 1, 1970. Since 1956, $39 billion has been spent on the interstate program.

One and two-tenths billion dollars in Federal funds for fiscal year 1971 have been apportioned for the continuing Federal-State program to improve primary and secondary highway systems. This program predates the interstate system, has expended a total of $27 billion over the years, and has aided in upgrading over 250,000 miles of highways.

Both of these major construction programs are funded exclusively from the Highway Trust Fund created by 1956 legislation. Revenue paid into the Fund in fiscal year 1969 totaled $4.67 billion. About 68 percent of this total comes from the 4 cent per gallon Federal tax on motor fuel; the rest is collected from various taxes on automotive products, trucks, and trailers.

Federally assisted highway construction has been the major determinant of growth patterns and development in this country since 1956. The program has given the American people a degree of mobility never before known. But the momentum of construction and the economic importance of new road building have raised obstacles to thoughtful long-range planning for the environment. Urban expressways have relieved congestion on our city streets but sometimes in the process have disrupted established neighborhood patterns, consumed urban parklands, and raised noise levels in residential areas. In some cases, expressways have abetted the conversion of downtown commercial districts into places that live only from 9 to 5. Construction of suburban arteries can easily be justified as a short-range solution to pressing problems of congestion. Yet it can also spur new development far from the city core, reward land speculators, create a need for more public services, destroy natural areas, dump more cars into the central city and promote a pattern of suburban settlement that nearly precludes mass transit.

Mass transit—Mass transit services have declined in many cities as riders turned to the automobile for the commute to and from work. However, failure to maintain and expand city bus, subway and commuter rail systems will lead to further congestion of expressways. And it will necessitate giving over more of the downtown areas to more expressways, parking lots, and garages. Mass transit legislation would award up to $3.1 billion over the next 5 years to State and local governments to help finance acquisition, construction, reconstruction, and improvement of mass transportation equipment and facilities. This legislation contemplates a full Federal commitment to the program of $10 billion over a 12-year period. It would permit State and local long-range public transportation planning to proceed in an orderly fashion, assured of uninterrupted Federal assistance.

Airports—The President's Budget for 1971 asks for $220 million in grants-in-aid for airport development and expansion. Available to burgeoning airports on a 50–50 matching basis, this money is for land acquisition, runway and ramp construction, and other airfield costs. The new Airport and Airway Development Act of 1970 envisions annual Federal appropriations over the next 5 years of $280 million.

But airports also have significant environmental impact. They bring high noise levels, new access highways, air pollution from automobiles and aircraft, and sewage and solid waste disposal problems. Airport construction requires that large land areas be cleared and leveled. This often means draining wetlands and other natural habitat areas to remove birds, small mammals, and other wildlife. Even more important, residential, commercial, and industrial activity cluster around airports, intensifying environmental threats manyfold. A proposed airport in the Dallas-Fort Worth area may attract support activities equal to a city of 80,000 people. Construction of a mammoth 39-square mile jetport just north of the Everglades National Park in Florida has been blocked by the Administration. If completed, it would have significantly disrupted the natural systems of the National Park and, worse, stimulated development already threatening the surrounding Big Cypress Swamp. The draining and filling of that swamp, the last natural flow of water to the western third of the park, would disrupt the hydrologic cycle and ecosystem of southern Florida and destroy the Everglades National Park.

Planning—Major Federal Government grants to fund comprehensive planning are distributed through three principal programs. Other specific functional planning grants are available from dozens of Federal programs. The Department of Housing and Urban Development (HUD) is the most important source. Its "701" program expends $50 million a year in direct aid to metropolitan areas and regions and in indirect aid to counties and smaller urban units. One and one-half percent of Federal Highway Trust Fund spending is earmarked for planning, although much of the $60 million available from this source is expended on transportation-related planning activities. HUD's Community Renewal Program also sets aside $12 million for planning.

Comprehensive regional planning can control the pace and direction of development. As such, it can be an important protector of environmental values. It also helps State and local officials coordinate various policies and programs and develop the framework to guide functional planning for schools, transportation, public utilities, or other specific purposes. There is a temptation at the Federal level and in many communities to use HUD funds for functional instead of comprehensive planning, thus losing the "glue" to hold together the disparate planning activities.

Sewer and water lines—A considerable block of Federal assistance—more than $500 million—is devoted annually to sewer and water projects that often affect land use.

The involved Federal agencies, particularly the Department of Housing and Urban Development, believe that past administration of these programs has augmented suburban sprawl and misdirected development. Builders and landowners know that they can develop lands far from built-up areas and use septic tanks and wells with the hope that funds will ultimately be available to extend sewer and water lines. Meanwhile, local officials delay construction of facilities in expectation of Federal funding. These outdated practices are undergoing challenge and change. And as new criteria are developed, Federal sewer and water grants can become useful to better direct the pace and pattern of growth.

There are three important Federal programs. The Department of Housing and Urban Development has a programming level of $150 million for 1970. Last year, three hundred and sixty five communities benefited from the program; most were suburban jurisdictions. The funds are not available for interceptor sewers or treatment plants. The Department of Agriculture has available for fiscal 1970 $190 million for water and sewer projects in communities of less than 5,500 persons; $64 million of this is for direct loans, and $80 million for insured loans; the remainder is grant monies. The Economic Development Administration of the Department of Commerce also funds construction of sewer and water facilities within its areas of jurisdiction. Expenditures for 1970 of $119 million are allocated primarily to economically depressed rural areas.

Open space—Acquisition of open spaces for recreation and conservation attracts growing public interest and government response. There are two major Federal grant programs. As described in the previous section on the natural environment, over half of the appropriations from the Land and Water Conservation Fund are available to States on a matching basis each year. Many States make a share of these funds available to local governments for purchase of small parks and recreation areas. The States have already used the Fund to purchase thousands of acres of recreation and conservation lands.

The other major open space grant program is operated by the Department of Housing and Urban Development under title 7 of the Housing Act of 1961. In the last 9 years, this program has spent $350 million in matching grants to acquire 350,000 acres of urban land for recreation, conservation, and historic preservation.

The combined impact of these two grant programs has significantly increased the land available in urban areas for recreation. Thousands of acres of urban open space have been preserved. But at the same time many thousands more were converted to residential, commercial, and industrial use by urban expansion. Some suburban communities have been among the most irresponsible in failing to provide adequate open space; many others have found their best efforts frustrated by soaring land costs.

Aids and Inducements to Individuals

The Federal Government over the years has loaned and granted money to individuals—among them homeowners and farmers. These programs have had noticeable side effects on the way the country has developed its land.

FHA-VA home mortgage programs—Buyers of 17 percent of the new housing units in the United States still choose Federally insured (FHA) and guaranteed (VA) loans to finance their homes. These programs were first implemented on a wide scale after World War II. Policies of low down payments and readily available low-interest loans provided financing for millions of families who otherwise would have been unable to buy new homes.

At the same time, by encouraging suburban home construction, these programs helped to form the concentric circles of racial and economic separation that persist in many metropolitan areas. Federal Housing Administration and Veterans' Administration examiners have traditionally favored new homes over restoration or renovation, and suburban communities over the urban core.

Agricultural programs—Farmers aid programs of the Department of Agriculture are a second set of significant inducements to individuals. Price support programs of the Commodity Credit Corporation are budgeted at $3.5 to $3.8 billion per year. These funds go to keep land out of production, prop agricultural prices, and provide farmers with loans against their crops. Each year the Farmers Home Administration provides $775 million in direct and insured loans for rural housing. Its Operating Loan Program furnishes $275 million annually for short-term purchases such as feed and equipment. The Farm Ownership Loan Program provides $225 million of direct and insured loans for the purchase of lands to expand or establish farms. And individual erosion control projects funded by the Agricultural Conservation Program amount to $200 million each year.

The original purpose of this aid was to protect the family farm and to encourage proper practices of agricultural conservation. Today intensive farming and modern methods of raising livestock often strain the capabilities of our lands and waters. Extensive use of pesticides and vast amounts of concentrated animal wastes are just two of the changes which have had profound environmental effects.

X

International Cooperation

Environmental problems do not stop at national frontiers, or ideological barriers. Pollution in the atmosphere and oceans taints all nations, even those benignly favored by geography, climate, or natural resources. The smokestacks of one country can pollute the air of another. Toxic effluents poured into an international river can kill fish in a neighboring nation and ultimately pollute international seas. Even in Antarctica, thousands of miles from pollution sources, penguins and fish contain DDT in their fat. And recent layers of snow and ice on the white continent contain measurable amounts of lead.

International cooperation, therefore, is necessary on many environmental fronts. Sudden accidents that chaotically damage the environment—such as oil spills from a tanker at sea—require international cooperation both for prevention and for cleanup. Environmental effects cannot be effectively treated by unilateral action alone.

Air and water pollution, moreover, are not the only environmental problems that have international aspects. Some world resources such as seabed minerals and ocean fish can be wisely dealt with only by international agreement. What nations do to clean up domestic pollution can affect international commerce. The costs of pollution control can change the competitive position of a nation's industry. And how the nations regulate international transportation and imports to eliminate sources of pollution can also have a profound bearing on trade. These considerations should receive increasing attention in the context of international trade policy. In addition, nations can reap economies and foreign policy benefits by undertaking joint research and environmental information sharing with other nations. Studies on pollution abatement, urbanization, population distribution, and the use of herbicides and insecticides, undertaken by one country, can help others.

The National Environmental Policy Act directed all agencies of the Federal Government to recognize the worldwide and long-range character of environmental problems. Where consistent with the foreign policy of the United States, it directs the agencies to support initiatives, resolutions, and programs designed to maximize international cooperation and prevent a decline in the quality of mankind's environment.

PROGRAMS WORLDWIDE

The United States is already engaged in international cooperation on environmental matters through a variety of channels. These include the United Nations and its specialized agencies and other such intergovernmental organizations as NATO, the Economic Commission for Europe and the Organization for Economic Cooperation and Development. It works with nongovernment organizations such as the International Biological Program and the International Union for the Conservation of Nature and Natural Resources. A number of environmental programs such as those discussed below are being developed by international agencies.

The United Nations

Economic Commission for Europe—The ECE, one of the four regional U.N. commissions on economic and social matters, is composed of the European members of the United Nations and the United States. Its current activities include air and water pollution control, urban development, and exchanges regarding government policy problems in these fields. It is preparing a Conference on the Environment in May 1971 in Prague. This conference will be a key preliminary to the full U.N. Conference on the Environment in 1972. The ECE is important as a forum for international environmental cooperation because it includes most of the major industrialized countries of the world, East and West, in working-level discussions of environmental problems.

Intergovernmental Maritime Consultative Organization—Since its establishment in 1959, IMCO has encouraged an exchange of research and information on the rapid, safe, and workable handling of oil spills and other aspects of ocean pollution. It has already established an international mechanism for reporting oil spills. In 1969 IMCO convened major international legal conferences on marine pollution. One proposed strengthening the 1954 Treaty on Prevention of Pollution of the Sea by Oil. The other proposed two new conventions to permit action to deal with damaged vessels threatening oil spills on the high seas and to fix liability for the costs of oil spill cleanup. President Nixon has submitted these treaties to the Senate for ratification.

U.N. Educational, Scientific and Cultural Organization—UNESCO promotes scientific investigation of man-induced and natural changes in the character of the oceans. It supports programs to identify effects of waste disposal at sea and to prevent depletion or extinction of valuable marine species because of man's activities. UNESCO-sponsored studies of atmospheric pollution are also underway. In 1968, UNESCO convened the International Conference on the Rational Use and Conservation of Resources of the Biosphere. Out of recommendations of that conference, it is developing a long-term, comprehensive program of research and action on environmental problems, called Man and the Biosphere.

World Health Organization—WHO has conducted studies of coastal pollution and is planning to lend technical guidance on coastal water quality and on ways to prevent pollution. It is developing a worldwide program of monitoring certain environmental conditions which directly affect health. WHO has also assisted many member countries in carrying out field projects on waste disposal and water pollution control.

Food and Agriculture Organization—FAO is undertaking studies on water quality criteria for fish, on pesticides and pollution, on pulp and paper mill effluents, and on sewage effluents. Although more concerned with pollution of inland waters, FAO has also turned to the study, monitoring, and management of the sources and effects of pollution on ocean fisheries. FAO also carries out ecological studies and surveys connected with land use, stressing increased productivity and management of natural resources, particularly in the developing countries. FAO has programs in wildlife management, in tourist development and protein production, in national park development, and in the traditional agricultural and forestry areas.

World Meteorological Organization—WMO has launched the World Weather Watch to improve the collection of meteorological data for forecasting and for studies of atmospheric pollutants. Basic research is being promoted and coordinated through the Global Atmospheric Research Program jointly organized by WMO and the International Council of Scientific Unions. Studies of the meteorological factors involved in air pollution are being conducted by two WMO commissions.

International Atomic Energy Agency—IAEA environmental activities concentrate on pollution from radioactive substances. It draws up regulations, conducts programs for exchanging information, and supports research projects. IAEA has published guidebooks on nuclear safety and radioactive waste management. With the World Health Organization and UNESCO, it has set up a worldwide sampling network to measure the amount of radioactivity in precipitation and is working on techniques for measuring atmospheric and other environmental radioactivity.

U.N. Conference on the Human Environment—The United Nations Conference on the Human Environment will convene in Stockholm in June 1972. Although the conference agenda has not yet been approved by the General Assembly, these fundamental purposes have been agreed to:

- To focus attention of governments and public opinion on the importance and urgency of environmental problems, both in developed and developing countries.
- To provide a forum for exchange of views among governments on ways of handling environmental problems, including legislative and administrative action.
- To identify environmental problems which can only, or can best, be solved through international or regional cooperation.
- To consider methods to meet the need for intensified action at the national, regional, and international levels—especially ways in which the developing countries can minimize or forestall the adverse effects of industrialization and urbanization.

- To encourage wider participation and support for the environmental activities and programs of U.N. bodies and other international organizations and to help give them a common outlook and direction.

A 27-member preparatory committee was formed early this year to prepare an agenda for the conference. At its first session in March, the committee defined three major agenda topics: population distribution and its effects on the environment, management of natural resources, and environmental pollution. The conference agenda will be refined at the January 1971 session of the preparatory committee.

Other Intergovernmental Bodies

NATO Committee on Challenges of Modern Society (CCMS)—An early expression of the U.S. growing concern with environmental problems was President Nixon's address to NATO in February 1969 and his proposal in April 1969 for the establishment of a NATO Committee on the Challenges of Modern Society. This new committee is designed to consider specific problems of the human environment. It has already underway eight pilot studies, and in five of them two or more of the member countries collaborate. The studies are on (1) disaster assistance (United States and Italy), (2) air pollution (United States, Turkey, and Germany), (3) road safety (United States and Germany), (4) open-water pollution (Belgium, Portugal, Canada, and France), (5) inland water pollution (Canada, France, United States, and Belgium), (6) scientific knowledge and decision-making (Germany), (7) motivation in a modern industrial society (United Kingdom), and (8) environment in the strategy of regional development (France).

Organization for Economic Cooperation and Development—The OECD, an assembly of the industrialized nations of Western Europe and North America, with Japan, has active programs on water resources management, air pollution, and pesticides. It is also organizing an environmental division which would study, among other things, these questions:

- Who should pay for the control of pollution, and who should pay for the damage caused by pollutants that escape into the environment?
- What is the level of acceptable exposure to various pollutants?

- Are there levels of pollutants in the environment which, if reached on a worldwide basis, will give rise to catastrophic changes?

Organization of African Unity—The OAU has directed attention to environmental problems and planning through the African Convention on the Conservation of Nature and Natural Resources, signed by representatives of 38 African nations at the OAU Summit Meeting in September 1968. This Convention, developed on the request of the OAU by the IUCN, with cooperation by FAO and UNESCO, is based on broad ecological principles and covers management, utilization, and preservation of natural resources including soil, water, vegetation, and fauna, and also includes aspects of research, education, administration, and legislation.

Organization of American States—Through the OAS the Latin American Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere was prepared in 1940, and subsequently ratified by the United States and 9 other American nations. The OAS has recently updated the Convention annex lists of threatened species, and is developing appropriate research programs which bear on the articles of the convention.

Council of Europe—This assemblage of European nations is making a commitment to environmental quality through its development of the European Conservation Year, initiated in January 1970. Each participating nation has developed its own major conservation program, and the Council serves as a point of liaison and coordination. The programs range from public education in pollution control to programs of basic ecological research.

Bilateral Cooperation

The United States is cooperating bilaterally with Japan, Germany, France, the Soviet Union, and Canada in joint research and information sharing.

With Japan the United States has arrangements for the exchange of scientific and technological information on air pollution, water pollution, toxic microorganisms, wind and seismic damage, and undersea technology. The United States-German program concerns coal dust, water pollution, air pollution control, urban planning, and noise abatement. The United States-Soviet Exchange Agreement covers oceanography, urban transportation, air and water pollution, and other environmental problems.

Cooperation between the United States and Canada on environmental problems has a long history. Their joint attention is now focused on the Great Lakes, St. Lawrence River water boundary, and on the Arctic region. United States-Canada agreements on the Great Lakes go back to the Boundary Waters Treaty of 1906. The Great Lakes is the largest fresh water body in the world. Most of the population of Canada and much of that of the United States lives near its borders, and pollution of the Great Lakes concerns both nations. The intergovernmental body chiefly responsible is the International Joint Commission of the United States and Canada. The IJC has developed an interim report on pollution of Lake Erie and other waters. On June 23, a ministerial meeting was held in Ottawa to discuss the IJC recommendations and future cooperation between the United States and Canada on Great Lakes pollution. That conference agreed on a number of specific proposals of the IJC and laid the foundations for a working group and further ministerial meetings. A final report is expected by the end of this year.

The Arctic region, a "last frontier" of natural resources in the Northern Hemisphere, is an area of growing importance in United States-Canadian consideration of environmental problems. Bordering international waters, it is important to the development of the United States and the North American continent in part because it affords the shortest distance between Eurasia and North America and in part because of its mineral resources.

The Arctic Ocean makes the United States a neighbor to five nations—U.S.S.R., Norway, Denmark, Canada, and Iceland. Still other nations share concern over exploration, settlement, and exploitation of the Arctic region. Environmental quality there is a new opportunity for cooperation among all these nations.

Nongovernmental Organizations

The International Council of Scientific Unions initiated the International Biological Program, a nongovernmental international scientific research project covering the biological aspects of the world's physical environment. The 5-year action program started in 1967 now involves scientists from more than 60 countries.

The International Union for Conservation of Nature and Natural Resources (IUCN) was founded in 1948. It comprises 29 nations and several hundred nonpolitical organizations from about 80 countries and maintains headquarters in Morges, Switzerland. The Union seeks to initiate and promote scientifically based action to preserve the natural environment, life forms, and resources. It works through commissions on ecology, species survival, national parks, education, and environmental policy and administration. The IUCN has consultative status with the United Nations and various regional international groups.

AREAS FOR FURTHER INITIATIVE

The United States should provide increasing leadership in environmental management affairs and lend support to the efforts of other nations and international agencies. The Council is now identifying new possibilities where the participation of other countries is necessary or where exchange of information and experience will buttress the environmental efforts of all nations.

Monitoring the World

The International Geophysical Year (1957–58) was a milestone in developing new knowledge on the physical and dynamic properties of the earth, including the composition and character of the oceans and the atmosphere. It helped provide fundamental baseline data on the global environment. The International Biological Program (IBP) is now developing a proposal for a global environmental monitoring system, which will consider ecological systems and their reaction to man's management of the global environment. Efforts are underway to identify pollutants in the atmosphere and ocean where critical situations may soon occur. Extensive study is required to determine what monitoring systems are needed, their costs, and organization.

Saving Endangered Life

The activities of man on earth have made extinct many forms of animal life. The rate of extermination has closely followed the rate of the world's human population growth. During recorded times the rate of extermination of mammals alone has accelerated from roughly one species each half century to one a year. About 40 percent of the known exterminations have occurred since 1900. Various international arrangements now seem necessary to keep the annual harvest of various endangered fish and animal life within their natural reproduction rates. There are a number of existing international treaties to do this, particularly those concerning fisheries, but many threats to existence continue unabated, among them the continued depletion of whale and other marine animal populations. Other threatened species with an international range, such as the polar bear, require tighter international protection.

The IUCN has moved to preserve examples of natural environment, life forms, and resources. The United States has also initiated legislative action to this end.

National Parks and the World Heritage

National Parks and historic sites provide permanent protection to the cultural, historical, scientific, and natural heritage of individual nations. There are many areas of extraordinary historic or natural value which may be considered part of a world heritage. The United States, which began its National Parks programs in 1872, has developed wide experience in park planning and management. The Council believes that the United States, drawing on this background, could and should give technical assistance to encourage other countries to take similar actions on their areas of natural and historic significance.

Such technical assistance, because it is designed to foster a world heritage, need not be limited to the countries in which the Agency for International Development has economic development programs. Nor need it be necessarily subject to economic criteria. The Council recommends that the Department of the Interior be given such additional authority as may be necessary to enable it to extend technical assistance in this area and in the closely allied areas of wildlife management. In carrying out such a program, it should consult with AID.

The Council further recommends that the United States undertake an initiative through the United Nations to encourage the establishment, on an international scale, of systems for the protection of the world's unique natural and historical areas. Rapidly rising population pressures, together with rapid and cheap transportation, make it mandatory that the nations act quickly. Such an initiative by the United States would be particularly appropriate in connection with the celebration of our National Park centennial in 1972 and the Second World

Conference on National Parks cosponsored by the Department of the Interior and IUCN.

Cooperation Under the Sea

Extraction of oil and natural gas from beneath the seabed is proceeding rapidly in many coastal waters, and techniques for drilling in deeper waters are being developed. Dredging or other forms of mining the deep seabed for mineral ores may become economically feasible.

Such exploitation of the ocean floor raises questions of rights and ownership as well as many problems of potential damage to the ocean environment. The United Nations is aware of these matters and has organized the U.N. Seabed Committee to make recommendations.

Unless environmental quality controls, resource conservation, and research go hand in hand with development, the use of the ocean floor could become another classic case of the tragedy of the commons—the single interest of each nation would run contrary to the collective interest of all.

President Nixon on May 23 outlined a proposal for sharing the responsibility for and the revenues from undersea resources among all nations, large and small, landlocked and coastal. He urged provisions for adequate environmental protection. The Council recommends that an international regime, developed to manage the seabed areas beyond the limits of national jurisdiction, include safeguards for the prevention of environmental damage.

Ocean Resources

A U.N. resolution, supported by the United States, has called for worldwide collaborative programs of oceanographic resource surveys to extend through the decade of the 1970's. Last October, this Nation outlined specific proposals for the International Decade of Ocean Exploration. The proposed activities address problems of worldwide concern which can be solved most swiftly and economically through multinational, cooperative efforts. They include:

- Preserving the quality of the marine environment through a better understanding of oceanic processes and living organisms;
- Improving environmental forecasting to reduce hazards to life and property; and

- Developing a global ocean monitoring system to assist in preventing harmful, irreversible manmade and natural modifications of the environment.

The Environment and International Development

International development programs, such as those supported by the Agency for International Development (AID) and the World Bank, have in the past primarily emphasized economic benefits without giving adequate consideration to the long-term ecological damage. In several cases pesticides have destroyed normal biological controls. Consequent increases of other insect populations have, in turn, led to further use of pesticides. Irrigation projects have led to water logging and salination of soils, sometimes with an actual net loss of arable land in given regions. Some highway construction has encouraged strip settlement with razing of forests, erosion, and destruction of watersheds. Inadvertent ecological damage may accompany otherwise well-intentioned development projects.

The lesson is not that international development programs should be avoided. It is that they should be based on long-range environmental factors as well as on engineering and economic factors.

The Council believes that the United States has a responsibility, when it gives development assistance, to advise the receiving nation of the ecological consequences of particular projects. The Council welcomes the steps AID has already taken in its project planning and review process to pay special attention to environmental factors, including research in areas where the necessary ecological information does not exist.

The Council recommends that the United States take initiatives, both in international discussions and as a participating member of various international development bodies, to gain acceptance of the principle that development programs must include environmental considerations in their planning and implementation.

Organizing Internationally

Building on the sound, already existing base of international cooperation, the United States may wish to consider proposing new institutional arrangements and greater specialization of existing international institutions to deal coherently and systematically with both immediate and long-range problems of the environment. For example, mechanisms should be studied to draw upon the world's best talent and technological knowledge for such purposes as monitoring the oceans and atmosphere, and serving as an authoritative, impartial center to warn of impending dangers and recommend action. Similarly, regional specialized groups might focus expert attention on such urgent problems of the less developed countries as urbanization, health, and water supply. Whatever form new initiatives take, the United States should be prepared to offer imaginative and vigorous support.

XI

Citizen Participation

A CHORUS of concern for the environment is sweeping the country. Private citizens, civic organizations, and communities everywhere are organizing and speaking out. Their concern is not tied only to their own local issues. It reaches to regional, national, and international environmental problems. It embraces pollution of the earth's air and water, noise and waste and the threatened disappearance of whole species of plant and animal life. Yet the focal point of the citizen's concern is best seen in the environment he sees deteriorating firsthand—his own community.

Parks have been bisected by highways, marshes drained and paved for industrial development, streams run underground, and shade trees ripped out of the city to make way for noisy, multilane expressways. Until recently, the average citizen regretted the destruction of his environment but accepted it as the necessary price of "progress." Now he has begun to ask if this kind of progress is really desirable, whether it can be achieved differently, and whether it is really worth the sacrifice of natural areas and assets.

The citizen's interest in saving and improving the environment is far from new. But in the past year or so, its center of gravity has shifted to a total "environmental" concept more suitable to an urban society. Fishermen, hunters, naturalists, and professional outdoorsmen, joined by a handful of scientists, hikers, and birdwatchers were the first to work for environmental causes. These early conservationists developed the concept of wildlife sanctuaries. They convinced legislators to institute hunting and fishing licenses to help pay for wildlife protection. Often the early conservationists worked against great odds to protect scenic and wilderness resources from destruction. If it were not for them, Yellowstone's natural geysers, the Grand Canyon, the California redwoods, the Everglades, and many other irreplaceable natural treasures might well have been permanently damaged.

Today the environment is a key concern of a wide variety of citizens, and they bring a new set of attitudes with them. They often speak a different language from the longtime professional conservationists, although the two are allies. Many of the newcomers are urban; yet they understand the intricacies of natural processes. Many of the new "conservationists" are in their teens and twenties; yet they tend to see urban problems as at least as important environmentally as the preservation of natural areas and natural resources. Often they choose more direct, active ways to express their views than traditional conservationists.

Citizen participation in environmental protection is being championed at the highest levels of government. In May 1969, the President named Laurance S. Rockefeller Chairman of the 15-member Citizens Advisory Committee on Environmental Quality. The Committee's task is to advise the President of the citizen viewpoint and to recommend roles which citizen groups can play in the national environmental effort. The committee has issued a progress report with proposals for action on such diverse items as urban recreation, solid waste, environmental education, and Federal licensing power. It has prepared a comprehensive citizen's guide titled "Community Action for Environmental Quality," giving information on programs and suggestions for individual participation in community action.

The National Environmental Policy Act of 1969 notes the importance of the individual citizen's role in enhancing the quality of the environment. The Act says: "The Congress recognizes that each person should enjoy a healthful environment and that each person has a responsibility to contribute to the preservation and enhancement of the environment" (title I, sec. 101(c)). Section 102(c) of the act makes available to the public the statements which all Federal agencies must submit detailing the impacts that their recommendations or proposals for legislation may have on the environment. Section 102(f) requires Federal agencies to make available to individuals advice and information useful in restoring, maintaining, and enhancing the quality of the environment.

LOCAL ORGANIZATIONS

Local citizen groups usually form in the face of a specific threat to the local environment. Groups have banded together to fight pollution in Lake Erie, land filling in San Francisco Bay, smog in Los Angeles, and the damming of the flood plains and wetlands of the Neponset River in Boston Harbor. Citizen organizations have worked against offensive smoke stacks in Winston Salem, N.C., and Butte, Mont. Groups in Baltimore, Washington, and San Antonio have blocked or changed highway development plans. Others have succeeded in keeping a freeway from going through the historic Vieux Carré section of New Orleans.

The urban environment has received special attention. In the New York metropolitan area alone, nearly 200 organizations are mobilized to deal with the environment. One, the Open Space Institute, which grew out of the temporary Open Space Action Committee, seeks to save natural lands and waters within the New York region from further development or subdivision. In Los Angeles, the Watts Labor and Community Action Committee has developed an urban recreation program to help develop "pocket parks" and to conduct cleanup campaigns. Local chapters of national organizations have often helped attract citizen attention to local environmental concerns.

THE CONSERVATION COMMISSIONS OF THE NORTHEAST

The growth of local conservation commissions in the Northeast, particularly in New England, has strengthened the citizen's hand in environmental decisionmaking. This movement may point to more effective citizen participation in other areas of the country as well. The conservation commission is a mechanism of local government for promoting direct civic involvement in setting and achieving local environmental goals. A commission typically consists of five to nine citizen members appointed by the mayor, city council, or other governing body of the community.

The commission movement began in Massachusetts, where it fits easily into the active local governmental tradition of the New England town meeting. Since the passage in 1957 of the enabling act, 276 towns and cities of the Commonwealth, representing nearly 80 percent of all its towns and cities and two-thirds of its land areas, have started conservation commissions. Through State and Federal matching funds, Massachusetts communities are now able to acquire and protect valuable land. The 101 commissions in Connecticut, representing about 60 percent of the State's communities, cooperate with the public schools to build educational parks. About 70 percent of municipal governments in Rhode Island have conservation commissions. In Maine, despite problems with the initial enabling law, many coastal communities have established conservation commissions which citizens hope will save sections of the Maine coast from inappropriate industrial development and attendant pollution. In 1968, a year after passage of enabling legislation, more than 50 New Jersey communities had commissions at work; 75 are at work now; 100 are expected to exist before the end of 1970.

By mid-1970, variations on the Massachusetts model were operating in about 600 local jurisdictions in the seven coastal States from Maine to New Jersey.

REGIONAL AND STATEWIDE ACTIVITY: THE CONSERVATION COUNCILS

Local and regional citizen organizations have united into State and regional conservation councils, or "organizations of organizations." A central council gives the varied local member organizations a common meeting ground and also acts as a clearinghouse of information about action at the State level for constituent organizations.

More than 34 States have at least one conservation council. At least six States have two, and Michigan has four. The number of constituent member organizations within any one council usually ranges from 20 to 60, with three councils having over 100 member organizations.

The councils have set for themselves a variety of goals and functions. Some stress education and the dissemination of information to members and the general public. Others have developed legislative programs and plans for political action, and a few have hired lobbyists to present their point of view to State legislators. Some have sought tax exempt status, but the majority have not, preferring to retain the potential of influencing environmental legislation.

Most of these councils rely heavily on services contributed by member organizations and volunteers, including local college students. Some councils have academic and technical consultants who provide engineering and scientific counsel and services. Income for most councils comes from membership dues. A small part of their income, perhaps 10 percent, comes from contributions and gifts. Membership organizations sometimes include business firms and associations and civic organizations. In some instances, charitable foundations provide financial backing for councils with the proper tax status.

A few regional citizen councils place more reliance on geographic than political boundaries. Their activity may center on a regional environmental problem, such as the pollution of a river which passes through several States, or on a particular natural phenomenon, such as the Grand Canyon or the highlands of West Virginia. The Potomac Basin Center, for instance, is concerned with the Potomac River, which is bounded by four States and the District of Columbia.

The strength of the regional council concept is illustrated by the Rocky Mountain Center on Environment (ROMCOE). This council focuses on the Rocky Mountains, which span eight States, a vast area with common climatic, economic, cultural, and historic characteristics. ROMCOE thus serves citizens with common environmental problems and interests.

NATIONAL ENVIRONMENTAL AND CONSERVATION ORGANIZATIONS

Over a dozen organizations with large memberships of citizens from all parts of the Nation exist to inform, guide, or represent their members in a wide variety of environmental and conservation matters. These include the National Wildlife Federation, the National Audubon Society, the Izaak Walton League of America, The National Recreation and Park Association, and Sierra Club, the National Parks Association, and the Wilderness Society. Another dozen or more with similar goals have memberships mostly of professionals in recreation or conservation fields. Other national organizations with broad interests—the League of Women Voters, the National Association of Counties, the Garden Club of America, the United

Auto Workers and the AFL-CIO—carry on substantial national environmental programs. Newer organizations, such as Friends of the Earth and Zero Population Growth, seek direct, active involvement in environmental controversies. Students are seeking a national voice in the environment through several action organizations.

Some national organizations have changed their traditional modes of operation and expanded their level of activity on environmental issues. They seek members who take active roles in local environmental controversies. Some organizations have separated their political and educational programs into two distinct but related entities for tax purposes—for instance, Friends of the Earth and the John Muir Institute; the League of Women Voters and the League of Women Voters Education Fund; and the Sierra Club and the Sierra Club Foundation.

The newer organizations, and several of the older ones, launch publicity campaigns to attract attention to environmental problems. The attention which Sierra Club books, exhibits, and newspaper advertisements attract has helped to more than double the club's membership in 2½ years—from 40,000 members in 1968 to nearly 100,000 today. The Sierra Club, which was founded in 1892 by John Muir, has evolved from a western outing club with few public environmental programs to an active organization that provides vigorous leadership in protecting natural places and processes, including recourse to the courts. Friends of the Earth, founded in 1969, a new organization attempting to influence legislation on a wide range of interests, also has brought several legal actions.

The Wilderness Society, in addition to providing national leadership, has concentrated on training local leaders, who then assume major local responsibility for identifying wilderness areas and organizing campaigns to set them aside and protect them through legislation. By training leaders, the Wilderness Society is able to decentralize its efforts and rely upon the large numbers of citizens across the country who are willing to give substantial amounts of time to help add to the extensive National Wilderness System contemplated by the Wilderness Act of 1964. Many other groups also rely on effective and active local chapters which assume a good deal of autonomy.

The Conservation Foundation, a non-profit research, education, and information organization, has brought together professionals and citizen leaders for conferences to explore such subjects as as environmental law and the ecological effects of foreign assistance programs.

The United Auto Workers have started a pilot air and water pollution prevention project in the "downriver" area of Wayne County, Mich., for families of Detroit factory workers. The AFL–CIO has joined in a number of efforts, including the "Citizen's Crusade for Clean Water," and has published a number of essays for union leadership on various environmental problems.

April 22, 1970, was Earth Day, nationwide. Organized by students, it was a day of lectures, meetings, teach-ins, and a variety of other events that drew an estimated 20 million citizens across the Nation. A staff of 25 students and hundreds of volunteers worked in Washington for 6 months to coordinate an Environmental Teach-in on Earth Day, which eventually involved an estimated 2,000 campuses, 10,000 high schools, and 2,000 communities nationwide. Colleges invited speakers representing government, industry, and educational institutions to discuss their responsibilities to the environment. In response to frequent exhortations to "work within the system," many activities were politically or institutionally oriented: one university group planned a full summer program examining congressional voting records on environmental issues; students in the Boston area collected 8,000 signatures on a petition supporting an environmental "bill of rights."

Environmental Action, a coordinating student organization, now continues activities that grew out of Earth Day. It publishes a biweekly newsletter, has issued a paperback book, "Earth Day: The Beginning," and has organized regional conferences so that Earth Day participants can evaluate the April 22 activities and plan future action.

The Department of the Interior's Task Force on Environmental Education and Youth Activities has helped establish a new national student organization—Student Council on Pollution and Environment (SCOPE). Through SCOPE's regional councils, student representatives make recommendations on policy, programs, and practices and act as an early warning system for environmental problems. Although only recently organized, SCOPE has already held two national meetings and convened several regional sessions.

Land Protection Through Private Purchases and Trusts

Private land trusts, regional groups, national conservation organizations and universities have for many years preserved areas of great scenic and natural value. The Nature Conservancy is the major private land-acquiring organization. It has about 20,000 citizen members and has protected over 400 separate areas in more than 40 States—a total of just under 190,000 acres. The Conservancy's program is growing rapidly; it acquired 40,000 acres in 1969 and another 40,000 in the first half of 1970. Since its founding in 1950, the Conservancy has grown from a loosely knit, meagerly financed, nonprofit group to a large organization. It relies on the expert advice of scientists and outdoorsmen in purchasing land or setting up land trusts involving thousands of acres and millions of dollars. Many of the areas saved would have been lost to private development if the Nature Conservancy had not intervened.

The Conservancy still owns and manages about one-third of the areas it has saved. It makes these areas available for public enjoyment or scientific research consistent with the preservation of the natural resource. Land which the Conservancy acquires is often conveyed to institutions, agencies, and sometimes the Federal Government. The Conservancy carefully writes provisions into the contracts to insure that the areas conveyed can never be used for purposes other than preservation. "Reverter" clauses provide that the land be returned to the Conservancy if commercial development or other incompatible uses occur.

Ducks Unlimited, a non-profit organization of approximately 40,000 members, has helped to acquire and rehabilitate significant amounts of wetlands on the Canadian prairie breeding grounds—thus helping to improve conditions for our North American waterfowl.

Citizen Groups in the Courts

Environmental organizations have begun to try to protect the environment through the courts. Redress through the judicial system, a relatively new tactic for citizens trying to restore the environment, has been encouraged by a series of recent Federal court cases which have held that citizens' groups now have the right to appear in court to seek legal remedies. Major cases include challenges to the sale of DDT, to the oil pipeline now proposed for arctic Alaska, to timbering in wilderness areas in Colorado, Michigan, and West Virginia, and to a proposed power generation station and a proposed freeway along the Hudson River.

Citizen's actions are also being brought to preserve open space and wilderness, to challenge highway route locations, and to abate various pollutants, including auto exhausts, factory effluents, pesticides, and municipal sewage. Actions are also being brought to secure full public hearings from administrative agencies or simply to get administrative agencies to move more rapidly and effectively and to keep the environment in mind in projected activities. In two recent cases involving DDT, citizens obtained court orders which required the Federal Government to act immediately to prohibit the sale of DDT or to give detailed reasons why the pesticide should remain on the market.

Suits initiated by citizens have begun to cite the National Environmental Policy Act of 1969, and its requirement for environmental impact statements, as noted earlier in this report (chapter II). The Act has already been cited in at least 16 cases and in 6 administrative hearings. In a Federal district court in Texas, a citizens' group cited the act to challenge successfully a Farmers Home Administration loan for the construction of a golf course in a nesting area of an endangered species of bird. In the Federal District Court for the District of Columbia, citizens successfully cited the Act in enjoining Federal permission to build a haul road across the Arctic tundra of Alaska in connection with the construction of an oil pipeline. Many other actions, not always by citizens' groups, rely on the protective language of the National Environment Policy Act.

Several public interest law firms specializing in environmental law recently have joined the limited number of private practitioners previously at work on environmental problems. Some large law firms donate part of their time and legal talents for work on environmental and urban problems. The Environmental Defense Fund and the Natural Resources Defense Council provide legal assistance when needed on behalf of environmental protection. Both the American Bar Association and the American Trial Lawyers Association have established committees to follow the growing interest of the bar in the development of environmental law. Environmental organizations have been formed at more than 50 law schools. And the Council on Environmental Quality has named a special advisory group of attorneys to advise it on legal issues.

Other Professional Responses

Besides lawyers, a number of other professionals find that their training is in demand by citizens' groups seeking expertise in solving complex environmental problems. Ecologists and other scientists from university faculties are in constant demand to advise or give expert testimony. Landscape architects and urban planners have design skills that are now being used to do a better job of building in harmony with the environment. The American Institute of Architects has established design concept teams that utilize varied design skills for creative solutions to specific local problems.

National Environmental Coalitions

Occasionally national environmental organizations will join other interested citizens to form a temporary, nationwide coalition to take a position or an action on an important environmental issue. One coalition of diverse citizen groups and conservation organizations formed to protect the Florida Everglades from changes in its water level and from the construction of a jetport nearby. Another coalition mounted a successful effort against the Timber Supply Bill of 1970, which would have permitted more extensive logging in National Forests. Still another, the Citizen's Crusade for Clean Water urged Congress to appropriate a larger amount than first planned for the construction of sewage treatment facilities.

The Natural Resources Council of America has, since 1949, provided many of the functions of a permanent national conservation coalition. It has concentrated, however, on coordinating pending legislation and administrative programs and on assisting member organizations in finding reliable sources of scientific information about resources. The Council has provided a basis for improving mutual understanding among member organizations of each other's objectives.

The coalitions show the ability of civic organizations to launch successful environmental campaigns. They also show that the common interests of a wide variety of conservation, environmental, and other civic organizations are much greater than their differences.

XII

Environmental Education

WHEN IT BEGAN to dawn on people that the environment was worsening, that blight was creeping across our land, that the air was polluted and the waters running with waste, one of the first questioning glances was toward education. Our educational systems were caught off guard by the decline in environmental quality. They were no more ready to cope with the decay than any other part of society. Now in the face of the challenge the systems must be broadened to include new perceptions of environmental education.

What do we mean by "environmental education"? Nobody is certain. It has never been adequately defined. Education at least should help the student understand how the natural world works, not just its parts, but the relationships of one to another. He must appreciate not only man's dependence on and contribution to ecosystems, but the ways and degrees by which modern man alters them. As history cannot be adequately seen just as a series of acts, dates, battles, and names, but as the fabric of our past in relationship to our present, so environment cannot be seen but as a web of relationships.

This need not necessarily mean that ecology should replace any particular course of study or that education should be devoted entirely to ecology. But it does mean that there is a need for interdisciplinary education to cope with the interrelated nature of the environment. It is clear that man does not know enough about the environment around him and what he is doing to it.

He has been a sorcerer's apprentice. He has loosed forces he only partly understands and can only partly cope with. It is not enough that experts know—and even they know precious little—but it is mandatory that the people who must live in the environment learn more about the forces that now move in sometimes dangerous ways upon it. Environmental education therefore is a key to making this a livable world.

That means, at the minimum, a fuller understanding of how the natural world works and how man is changing it. A better idea of how our economic systems and political institutions influence the choices that set off chain reactions within our environment, and a shift in personal values to make us willing to pay the price of controlling pollution, will both be necessary.

The Council is not ready yet to suggest how these needs must be woven into America's educational system. The picture is beset with too many conflicting, but legitimate, positions. They should be thoroughly debated.

Environmental education is not only "conservation education." Nor is it only the sum of the antipollution concerns that have recently captured public imagination. An "environmentally literate" individual is one who understands that he is part of a system composed of people, culture, and his physical and natural surroundings. He knows that man's acts can change his relationships to this system. He appreciates the human ability in some degree to control, preserve, and destroy the environment. He accepts responsibility for the condition of his environment. But that does not mean that he knows what to do about it.

A mere scientific study of earth's life support systems is inadequate. Environmental decisions are also based on economic and political factors, social pressures, and cultural values. Many Americans live most of their lives in cities. So it is essential that environmental education be relevant to them. That means that it must stress social and behavioral sciences. It should deal with what the student's environment is and might be. More colleges must begin to weave environmental content into science, technology, law, government, and education courses. And for the long run, perhaps more important than any of these actions, pre-school, elementary, and secondary school students must be exposed to environmental learning. That exposure involves curriculum development, teacher training, and organizational reform of a type and on a scale that do not now exist.

EDUCATION THAT CANNOT WAIT

Intelligent environmental action, however, cannot await the emergence of a new generation whose environmental literacy is the product of education from kindergarten through 12th grade and beyond. Therefore, major attempts are underway to educate and motivate the present adult population, primarily through the mass media and community projects, focusing on local problems.

During the past year every broadcasting network and major newspaper and magazine has written on environmental problems. To assure a sustained educational effort through the media, the U.S. Office of Education, Department of Health, Education, and Welfare, awarded funds to the Corporation for Public Broadcasting to establish an Environment Center. The center will provide television programs and radio materials designed to increase public awareness of environmental problems. It will help prepare teachers for environmental education and train others for careers in environmental management industries.

Environment-oriented education projects are appearing in greater numbers in schools and communities throughout the country. The examples that follow illustrate the diversity of these programs but should not necessarily be considered models.

Oak Ridge Associated Universities (ORAU), in Tennessee, plans to develop several mobile environmental laboratories in 40-foot tractor-trailers manned by trained teacher-demonstrators. These laboratories will set up in supermarket parking lots and near museums and other public places throughout the Nation. Mobile environmental education classrooms—slightly smaller vans to circulate among schools—will operate continually out of ORAU throughout the school year The mobile labs and classrooms will stress dramatic demonstrations of some of the more subtle problems of environmental contamination and what can be done to improve environmental quality.

Historically, private organizations such as the Sierra Club, the Izaak Walton League, the Conservation Foundation, the National Audubon Society, the American Forestry Association, the National Wildlife Federation, the National Recreation and Park Assocation, the Wilderness Society, and the Massachusetts Audubon Society have led in prodding public environmental awareness. Museums and parks have been regular staging grounds for special education programs. These and other groups should continue to be enlisted in the environmental education efforts of schools, colleges, and communities.

Higher Environmental Education

New forms of instruction have evolved in several colleges and universities to broaden understanding of the environment and human relationships to it. These have ranged from injecting environmental concepts into traditional subject areas to establishing whole institutions that are multidisciplinary or problem-solving in orientation and approach. Heavy emphasis also has been placed on learning through direct observation and participation.

Environmental law is a rapidly developing field of education from the high school level through the law schools and into the practicing law institutes. Some law schools are adding environmental law to their curriculums and are making it the subject of advanced seminars. Environmental litigation, new and proposed legislation, law review articles, and other materials on the subject are spurring bar associations to form environmental law committees and to hold institutes for their members. Environmental law courses which involve students in litigation are also of growing interest in adult education and citizen study and action groups.

New courses dealing with man and his environment are being established in colleges and universities throughout the country, and old courses are being remodeled to emphasize man's relation to the world in which he lives. Some of the courses bear familiar names—as Ecology 1 or Biology 101. But many carry more intriguing titles: Biology and Society, Social Responsibility of Scientists, History of Environmental Perception, and Social Impact of the Biological Sciences.

In 1969, the University of Wisconsin at Green Bay started a full academic program focused on ecology. In recognition that environmental education cuts across conventional boundaries of academic disciplines, the four colleges within the university complex are organized around themes rather than disciplines. The central themes are environmental sciences, community sciences, human biology, and creative communication.

Innovation in the Schools

At the elementary and secondary levels, the trend is toward weaving new material into established courses and using the environment itself and community resources to teach youngsters what they need to know.

In South Carolina a State-sponsored, 6-year project has produced eight curriculum guides for teachers, grades 1–12, in science, social studies, home economics, and outdoor education. The guides consist of over 400 lessons which any teacher can use to introduce, develop, and expand environmental concepts.

The National Park Service's National Environmental Education Development (NEED) program, partially funded by the National Park Foundation, tries to relate the individual child to his own environment through a simple set of five basic ecological principles. The NEED program has produced teacher guides and student materials for grades 3 to 8 and eventually will cover kindergarten through 12th grade. Each lesson involves development of a major ecological theme, the perception of how the principle works, and its meaning to the individual. Pivotal to the use of the NEED materials is the development by the National Park Service of National Environmental Study Areas (NESA). The NESA program is a nationwide, environmental education, joint endeavor with local communities. It uses NEED materials together with the regular school curricula to develop an awareness and understanding of the total environment, the student's relationship to it, and a sense of responsibility for it. NESA's may be natural, historical, or cultural. The majority of them eventually will probably be located within or close to urban areas. The NEED program emphasizes the idea that environment is everything and everywhere and that urban environs are proper places for its study. But the field trips which are a part of the NEED program give many city-bound school children their first taste of another environment as well.

New York City's Center for Urban Education has launched Planning for Change, a civic action program that involves upper elementary-grade children in environmental improvement projects. The Conservation and Environmental Science Center at Brown's Mills, N.J., is operated by a consortium of more than 60 school districts. Established with Elementary and Secondary Education Act, title III, funds from the U.S. Office of Education, it has developed curriculum guides and college-sponsored courses. It also aims to produce new material for environmental education in urban, suburban, rural, and marine settings. The center also conducts 1-day field study programs and week-long resident programs.

The Audubon Naturalist Society and the Logan Community School in the District of Columbia together developed a continuing program on environmental awareness and ecological concepts for fifth and sixth graders. That program takes a natural area to compare and contrast with the urban environment. The Philadelphia Parkway Program, a year-round experimental high school project, uses the total city environment as the classroom and the life of the city as the curriculum. This model has recently been adopted by the city of Chicago. Washington, D.C., and San Francisco have developed similar projects, scheduled to begin this fall.

National conservation and environmental organizations conduct myriad educational efforts aimed at both the classroom and the public. The Conservation Foundation has produced educational films. And it publishes the monthly "CF Letter," a roundup of environmental issues. The National Wildlife Federation issues "Conservation News" and puts out educational materials under its "Ranger Rick" program. The National Audubon Society runs ecological workshops for school teachers. And in consort with the New York City Schools, it has launched a study series titled "A Place to Live" for fourth, fifth, and sixth grade students living in an urban environment.

Several national organizations keep close track of what the Federal Government is doing in the environmental area. The Natural Resources Council of America puts out "Legislative News Service" and "Executive News Service." The Sierra Club publishes a bulletin of current information on events in Washington.

Conferences and workshops are becoming commonplace. The National Recreation and Park Association is teaching park interpretation to park guides—from the point of view of public understanding and involvement. The Conservation Foundation has conducted, and the League of Women Voters Education Fund plans to conduct, air quality workshops to help local leaders assess air quality standards proposed in their States. These workshops have been cosponsored by a battery of civic, health, and religious organizations, many of them new to environmental forums.

Each of the national goals outlined in the National Environmental Policy Act has an educational component from which specific environmental educational policies can be derived. Eventually these national goals must be translated into regional, State, community, and local environmental education objectives.

The responsibility for environmental renewal and restored ecological balance is a task for the total society. If the goal of improved environmental quality is to be reached, the bulk of the population must improve its understanding of the ecological system and how man's actions affect it.

TRAINING ENVIRONMENTAL MANPOWER

Equipping the Nation for intelligent and effective environmental management will require specific skills. As we begin to solve the most immediate environmental problems, manpower training efforts must be vastly accelerated. Government and private groups in the next decade will spend billions of dollars for physical facilities. Plants, laboratories, and research stations dealing with the environment are now understaffed, and projections show that this personnel shortage will worsen. Technicians will be needed, in far greater numbers than are now being trained, to cope with problems of water supply, waste water treatment, solid waste management, and air pollution control.

Efforts are underway to train additional technicians, particularly the disadvantaged, with emphasis on moving them quickly into the job stream. There is need for new programs to train technicians who have fundamental technical skills and can easily adapt to constantly emerging job categories. It may be possible, for example, to modify, coordinate, or merge some of the present specialized technician programs into broader environmental technician programs. Community and junior colleges are especially suited to provide innovative training for environmental technicians.

The most urgent future environmental manpower need is for waste water treatment plant operators and technicians. The Federal Water Quality Administration (FWQA) estimates that jobs for 28,000 new waste water treatment plant operators and technicians will open up over the next 5 years. And 36,500 operators and technicians must be retrained to higher skills. FWQA-assisted projects trained 981 operators in 15 States and in Puerto Rico in 1969. Approximately 2,800 operators in 30 States will be trained during 1970. FWQA also is working with the Department of Defense to attract returning servicemen to the pollution control field through DOD's "Project Transition." A pilot program will train approximately 300 servicemen as treatment operators.

FWQA also manages a program of grants and fellowships for training professional and scientific manpower. Training grants in 1970 will support 693 trainees, most of whom are working toward master's degrees. Research fellowships are also awarded in work toward Ph. D. degrees. Approximately 100 students are supported each year in this way. Finally, FWQA provides special short-term courses—more than 50 courses—just last year, reaching some 1,300 persons.

To meet some of the most critical immediate manpower needs, the Department of Health, Education, and Welfare (HEW) and the Department of Labor are helping to set up special pre-admit community college programs and postsecondary technical school programs on the environment. Manpower Development and Training Act (MDTA) funds have been earmarked for these programs which will train disadvantaged youths for careers as environmental technicians. HEW's Office of Education has committed MDTA funds for workshops to help community colleges and local vocational and technical schools develop curriculum and projects for environmental manpower training. The Office of Education and the Department of Labor are recruiting disadvantaged, unemployed young adults and enrolling them in the special community college programs.

HEW's Environmental Health Service (EHS) is considering an environmental manpower planning system. Work on the proposal is underway now in concert with several other Federal agencies—the Environmental Control Administration and the National Air Pollution Control Administration, both of EHS; the Federal Water Quality Administration in the Department of the Interior; the Department of Housing and Urban Development; the National Science Foundation; and the Department of Transportation. The proposed system will lay a common framework for evaluating and stimulating efforts of the several agencies as they relate to State, local, and private sector planning.

EHS will develop a "Dictionary of Occupational Definitions" and a "Guide to the Development of Staffing Patterns and Manning Charts." Other steps are: development of national estimates of environmental manpower supply, vacancies, needs, and production; collection of data on staffing levels necessary to attain a determined level of environmental quality; and production of workable models for predicting manpower demand and supply.

Public Health Service agencies support a mix of environmental education programs in colleges and universities and conduct an array of technical short courses and seminars for community leaders. The programs aim to prepare specialists and generalists for prevention and control of environmental hazards and for research in environmental sciences.

The National Air Pollution Control Administration is developing manpower regionally. It envisions 12 centers in or near major metropolitan areas. At each site a university consortium will be developed to improve the quality and quantity of training and research. The consortia will expand the involvement of the participating universities in air pollution control by deepening their interrelationships in cooperative research and curriculum development.

XIII

Present and Future Environmental Needs

THIS REPORT has looked closely at particular environmental problems. It has looked at what is being done now to combat them. And it has looked at what might be done in the days, months, and years ahead. The agenda for urgent action is long. Much has already been done, but much more must still be done with current management tools wielded by existing institutions. Moreover, the pace of change in programs underway promises, over the next few years, to brake even further what has seemed a headlong careening toward environmental decay.

The pressing need for tomorrow is to know much more than we do today. We lack scientific data about how natural forces work on our environment and how pollutants alter our natural world. We lack experience in innovating solutions. We lack tools to tell us whether our environment is improving or deteriorating. And most of all, we lack an agreed upon basic concept from which to look at environmental problems and then to solve them.

NEEDED—A CONCEPTUAL FRAMEWORK

A problem is said to exist when our view of what conditions are does not square with our view of what they should be. Problems, in short, are products of our values. People agree—for example, that a river should not be polluted. And when they see that it is, water pollution becomes a problem. But some of the values dealt with in this report are not unanimously agreed upon. The chapter on land use is critical of urban sprawl; yet many Americans choose to live in dwellings which abet such sprawl. This uncertainty about what values are relevant to environmental questions and how widely or strongly they are held throws up a major obstacle to conceiving environmental problems. How much value do Americans place on the natural environment as against the man-made environment of cities? How much do people value esthetics? Do they agree about what is esthetically desirable? These and a host of similar questions must be raised when trying to align priorities for coping with environmental decline.

Our ignorance of the interrelationship of separate pollution problems is a handicap in devising control strategies. Is pollution directly related to population or to land use or to resources? If so, how? Indeed, does it do any good to talk about pollution in general, or must we deal with a series of particular pollution problems—radiation, pesticides, solid waste? A systems approach is needed, but what kind of system? The pollution system, the materials and resources use system, the land use system, the water resources or atmospheric system? In this report the Council has suggested tentative answers to some of these questions. But much more thought is necessary before we can be confident that we have the intellectual tools necessary to delineate accurately the problems and long-range strategies for action.

Experience will help resolve some of the conceptual problems. We already know what problems are most pressing. Clearly we need stronger institutions and financing. We need to examine alternative approaches to pollution control. We need better monitoring and research. And we need to establish priorities and comprehensive policies.

NEEDED—STRONGER INSTITUTIONS

Most of the burden for dealing with environmental problems falls to governments at all levels. And the Nation's ability to strengthen these institutions is central to the struggle for environmental quality. To make them stronger, fundamental changes are necessary at Federal, State, and local levels of government. Chapter II of this report treats in detail the President's proposed improvements in the Federal Government for better environmental policy development and management. Although these changes will not be the final answer, they do lay the base for a comprehensive and coordinated Federal attack on environmental problems.

States play a key role in environmental management because of their geographic scope and broad legal powers. Many have reorganized to focus comprehensively on environmental problems. Many are helping municipalities build sewage treatment plants; some are planning statewide treatment authorities to construct and operate plants. And California has led the Nation in trying to curb automobile air pollution since the 1950's. In land use control many States are carving out larger responsibilities for land use decisions of regional scope.

In many respects local government, of all the levels, most needs institutional improvement. It has suffered from fragmentation, from skyrocketing demands and costs for public services, and from generally inelastic tax sources. The financial burden of environmental improvement staggers local governments. Most of the costs of water pollution control, both capital and operating expenses, come from their budgets. In some cities, efforts to deal with combined sewer overflows raise almost insuperable financial and technical hardships. Solid waste disposal is a major expense for most local governments, and the costs grow as disposal techniques are upgraded, as land grows scarcer, and as wages spiral. On top of its financial headaches, local government is caught in a tangled web of overlapping and conflicting jurisdictions that hamstring solutions to land use and air pollution.

Existing institutions must be made better and, in some cases, new institutions created to deal with the environment. Occasionally more funds, personnel, and public support are all that is necessary. Other cases call for a more fundamental restructuring. This may mean extending geographic coverage and operational capabilities. Air and water pollution, for example, do not respect political boundaries, so institutions covering entire watersheds or airsheds may be necessary to cope with them. Important aspects of land use planning, review, and control may need to be shifted to regional or State levels as the only way to tie land use needs together over wide areas. And new forms of land use criteria may be necessary to reverse the current myopia of local government zoning.

Many environmental problems cross not only local, state, and regional boundaries, but international boundaries as well. Control of pollution of the seas and the atmosphere requires new forms of international cooperation—for monitoring, research, and regulation.

NEEDED—FINANCIAL REFORM

Financing for environmental quality is in need of dramatic overhaul. Liquid and solid waste collection and disposal by local governments represent an indispensible service—not unlike electricity and water. Yet rarely do the users of these services, industry and homeowners, bear the full costs of operation and amortization. Rather, financially beleaguered local governments subsidize these services. The current method of financing, therefore, is not only inequitable; it encourages a greater accumulation of waste by industries because they do not bear the full costs of disposal. It deprives local governments of needed funds to operate and maintain waste disposal facilities properly. In short, it contributes to the sorry performance of facilities in the United States in treating sewage and disposing of solid wastes. If future demands for environmental improvement are to be funded adequately, better methods of financing must be developed.

NEEDED—POLLUTION CONTROL CURBS

This report discusses many tools for curbing pollution. Most have been regulatory. For centuries authority to regulate has been wielded to a limited extent—more broadly by the middle of the 20th century.

But there is considerable debate whether regulation represents the best course of action. Economic incentives have won increasing support as a pollution control weapon. Charges or taxes on the volume of pollutants—say, 10 cents a pound on oxygen-demanding material—are another lever that might spur industry to reduce wastes. The charge system, some say, would not only be more economic but also more effective compared to the traditionally cumbersome enforcement process.

In this report the Council urges stricter and more systematic enforcement of air and water standards. That cannot be done, however, without better monitoring and data—as well as clear-cut, enforcement policies that will leave no doubt of responsibilities on the part of the private sector.

The Council believes that economic incentives offer promise, especially if backed up by regulatory power. It believes that they should be selectively demonstrated. And it believes that effluent or emission charges should be evaluated as a supplementary method of stimulating abatement measures.

NEEDED—MONITORING AND RESEARCH

Effective strategy for national environmental quality requires a foundation of information on the current status of the environment, on changes and trends in its condition, and on what these changes mean to man. Without such information, we can only react to environmental problems after they become serious enough for us to see. But we cannot develop a long-term strategy to prevent them, to anticipate them, and to deal with them before they become serious. For example, we became aware of the mercury problem only after it had become critical in some areas and had probably done environmental damage. Yet we still do not know the extent or significance of that damage. Our attack on the problem can now be but a cure or a cleanup. It has already happened. However, if we had possessed an adequate environmental early warning system, we would have been able to anticipate mercury pollution and take early action to stop it at its sources.

We do not know what low-level exposure to most pollutants does to man's health over the long term. Nor do we know how people react to changes in their environment. The challenge to the social sciences is to develop entirely new gauges to measure environmental stress.

What do crowding, urban noise, and automation do to man? These are critical questions. We do not understand enough about the interactions of different environmental forces such as urbanization, land use, and pollution. We do not even understand many of the natural processes that play critical roles in environmental well being—such as changes in world climate.

To obtain such information, a comprehensive program is required. It involves nationwide environmental monitoring, collection, analysis, and—finally—effective use of the information. In the case of some pollution, such monitoring should be international.

The first step is to identify the environmental parameters—things in the environment which are or should be measured. These range from substances such as DDT, sulfur dioxide, and lead to percentages of open space in the cities, visitor use of parks, and survival of species. Once identified, the parameters must be monitored—measured on a regular, repeated, continuing basis. In this way, baselines of the present status can be determined and changes from that base detected.

Environmental indices can be developed from these data. Indices are data aggregated to provide a picture of some aspect of environmental quality—for example, the quality of air as it affects human health. They are not unlike the cost of living index by which economists measure the status of the economy and by which housewives measure their budgets. Some environmental indices—and the parameters on which they are based—are easily identified and measured. For example, conditions that clearly affect human health in air or drinking water can be easily detected. Other indices and parameters are based on value judgments and are much more difficult to deal with. The quality of National Parks and scenic beauty are examples. To develop indices, the information from monitoring must be collected, translated into a usable form, and analyzed. Good indices do two important things. They inform the general public of the quality of the environment, and they inform the government and other decisionmakers who can take action. Good indices show the current environmental quality on a national or local scale and whether this condition is improving or degrading.

At present no nationwide environmental monitoring and information system exists. Federal, State, and local agencies now collect a variety of data. Many of these data, however, are obtained for limited program purposes or for scientific understanding. They are fragmentary and not comparable on a nationwide basis. Although it may be possible to use some of these in the comprehensive system which is needed, at present they do not provide the type of information or coverage necessary to evaluate the condition of the Nation's environment or to chart changes in its quality and trace their causes.

Therefore, a major national objective must be to develop a comprehensive nationwide system of environmental monitoring, information, and analysis. The Council has initiated a study of the nature and requirements for the early development of such a system. However, even after we have developed a system, we must then have additional knowledge to enable us to understand and interpret the data we get. We are not yet in a position to understand the significance of the monitoring results to man and to natural systems. More research is needed on how the environmental systems operate and on the impact of man on the environment and its impact on him. Consequently, augmenting such research must take a high national priority.

NEEDED—A SYSTEM FOR PRIORITIES

It is difficult, given the current state of environmental knowledge, to set long-term priorities for the future. Relevant measures of environmental quality are often not available or, if available, are inadequate. These difficulties are compounded by great regional differences. For the present we can use our limited current data to identify pressing problems for immediate attention. In the future, the difficult task of deciding the Nation's environmental priorities, however, must be faced. Resources for combating environmental blight and decay are limited. Choices will have to be made on which problems have first claim on these resources. Four main criteria should determine this priority:

- The intrinsic importance of the problems—the harm caused by failing to solve them.
- The rate at which the problems are going to increase in magnitude and intensity over the next few years
- The irreversibility of the damage if immediate action is not taken
- The measure of the benefits to society compared to the cost of taking action.

The process of setting priorities is difficult. There is deep conflict over which problems are most important. And the inertia of on-going activities is a major obstacle. There are conflicts between the needs of industry and the needs of the environment. And the public yearning for more conveniences clashes often with the best interests of the ecology. Nor will the priorities of the Federal Government always coincide with those of State and local governments. The Federal priorities will be broad and national. States and localities, however, will often give higher priority to other aspects of environmental quality. As long as these other levels of government at least meet national standards, the imposition of higher standards in some areas is welcome. Whatever the divergences, diligent application of priorities will be necessary to make any real progress toward a high quality environment.

NEEDED—COMPREHENSIVE POLICIES

As priorities are developed, policies must be devised to translate them into action. These policies may consist of a mix of activities aimed at a particular goal. Dealing with many environmental problems will require a battery of economic incentives, regulations, research, and assistance programs. In some areas, policies cannot be developed until more information is available. In other areas, they can and should be developed now.

For example, the need for a national energy policy is clear. As the demand for power increases rapidly, new power facilities have to be built. Power plants will pollute the air with oxides of sulfur and nitrogen, the water with heat, and the landscape with mammoth towers and obtrusive power lines.

This environmental harm cannot be wholly averted now, but it can be limited. For the short term, the design and siting of power generating facilities and transmission lines must be better planned and controlled. But for the longer run, a national energy policy should be developed. It would require a comprehensive analysis of energy resources and actual needs. It would provide for wise use of fuels, both conserving them for the future and lessening environmental damage. For example, wider use of nuclear fuel, natural gas, or low sulfur coal and oil would lower sulfur oxide levels in critical areas.

As national transportation policies are shaped, air pollution is one among several critical environmental factors that must be considered. Although air pollution can be abated by enforcing emission standards, control devices for individual vehicles and other technological solutions may not be enough in the long run to keep air pollution from worsening as population and the number of automobiles continue to increase in the cities. One part of a transportation policy should be the continued examination of alternative means of curbing auto emissions, such as the development and use of systems combining the flexibility of the individual automobile with the speed of modern mass transportation.

Control over land use, a critical need of the seventies, is lodged for the most part in local governments. And often local solutions are piecemeal and haphazard. The local property tax favors the single-family residence on a large lot over types of housing less wasteful of land. Planning often fails to take into account the impact of development on the natural surroundings and often is not heeded by local governments. All these factors together lead to a series of local zoning decisions and regulatory action that perpetuate urban sprawl.

The State role in land use control has traditionally been small because most of the authority has been delegated to local governments. And direct Federal control over local land use is smaller still. However, the Federal Government can influence how land is used through planning and capital grants. Under existing programs the Federal Government, by its actions, could spur more modern land use methods. It could encourage cluster zoning and timed development. It could identify natural areas for preservation and encourage channeling of future growth in more rational patterns.

The problems of land use are complicated and diffuse. And the challenge is to center all the capabilities of all levels of government in a coordinated attack on them. The problems and the challenge together argue for a national land use policy.

Population growth and economic growth are potential wellsprings of environmental decay. They increase the demands upon limited natural resources. The U.S. population will continue to grow for the next few decades. But environmental quality is difficult to achieve if population growth continues. The President has appointed a commission on Population Growth and the American Future, headed by John D. Rockefeller III, which will explore the policy implications of future population growth.

The development of knowledge will doubtless indicate many new areas in which national policies are appropriate. And as these policies are developed, specific programs for implementation must then be formulated.

CONCLUSIONS

The year 1970 represents a pivotal year in our battle for a clean environment. The Nation is committing resources at all levels of government and in the private sector. Public support is at an all-time high. And the President's proposal for consolidation of anti-pollution programs, coupled with the Council's policy advisory and coordinating role, provide an opportunity to look at environmental quality in new ways.

This report emphasizes the need to move aggressively now to deal with problems that can be dealt with within existing knowledge and by existing institutions. For the long term, we need much more knowledge of values; the scope and nature of environmental problems; status and trends in the environment; the workings of natural processes; and the effects of pollutants on man, animals, vegetation, and materials. As we gain this knowledge, we will need to develop the institutions and financing mechanisms, the priorities, the policies, and finally, the programs for implementation. Without such a systematic approach, the current piecemeal, unrelated efforts will achieve only partial and unsatisfactory progress in meeting environmental problems of tomorrow.

This report emphasizes that changes in one part of the environment inevitably trigger changes in other parts. These complex interactions of environmental processes must be looked at as a whole. While keeping in mind the indivisibility of the environment and its intricate interrelationships, it is also necessary that some segments be treated separately when attacking environmental decay. Water pollution caused by a specific source may affect an entire ecosystem. But enforcement action must be taken against the particular source, not against the ecosystem. The major portion of this report has dealt separately with interrelated environmental problems, but only because of the inadequacy of our current framework for considering the environment and the need to focus attention on particular problem areas.

The National Environmental Policy Act of 1969 clearly stresses the necessity of approaching environmental problems as a totality. The act requires that Federal decision making incorporate environmental values along with technical and economic values; that both short- and long-term effects be given careful consideration; and that irreversible actions and commitments be carefully weighed.

National environmental goals must be developed and pursued in the realization that the human environment is global in nature, and that international cooperation must be a principal ingredient to effective environmental management.

All levels of government should function in two distinct ways: Within their geographic scope and needs, they must consider and plan for the environment as an interrelated system. But at the same time they must make specific decisions and take specific actions to remedy environmental problems. These two levels apply to action by individual citizens and private institutions as well. Our view of the environment and its value is changing and will continue to change. But these changes have effect only as they relate to specific choices by local communities, by particular industries, and by individuals. People in the end shape the environment. If a better environment is passed down to future generations, it will be because of the values and actions of people—all of us—today.

Appendices

APPENDIX A

The National Environmental Policy Act of 1969, Public Law 91–190, January 1, 1970

AN ACT To establish a national policy for the environment, to provide for the establishment of a Council on Environmental Quality, and for other purposes

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "National Environmental Policy Act of 1969".

PURPOSE

SEC. 2. The purposes of this Act are: To declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation; and to establish a Council on Environmental Quality.

TITLE I

DECLARATION OF NATIONAL ENVIRONMENTAL POLICY

SEC. 101. (a) The Congress, recognizing the profound impact of man's activity on the interrelations of all components of the natural environment, particularly the profound influences of population growth, high-density urbanization, industrial expansion, resource exploitation, and new and expanding technological advances and recognizing further the critical importance of restoring and maintaining environmental quality to the overall welfare and development of man, declares that it is the continuing policy of the Federal Government, in cooperation with State and local governments, and other concerned public and private organizations, to use all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans.

(b) In order to carry out the policy set forth in this Act, it is the continuing responsibility of the Federal Government to use all practicable means, consistent with other essential considerations of national policy, to improve and coordinate Federal plans, functions, programs, and resources to the end that the Nation may—

(1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;

(2) assure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings;

(3) attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences;

(4) preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity, and variety of individual choice;

(5) achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and

(6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

(c) The Congress recognizes that each person should enjoy a healthful environment and that each person has a responsibility to contribute to the preservation and enhancement of the environment.

SEC. 102. The Congress authorizes and directs that, to the fullest extent possible: (1) the policies, regulations, and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in this Act, and (2) all agencies of the Federal Government shall—

(A) utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decisionmaking which may have an impact on man's environment;

(B) identify and develop methods and procedures, in consultation with the Council on Environmental Quality established by title II of this Act, which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decisionmaking along with economic and technical considerations;

(C) include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on—

(i) the environmental impact of the proposed action,

(ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,

(iii) alternatives to the proposed action,

(iv) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and

(v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

Prior to making any detailed statement, the responsible Federal official shall consult with and obtain the comments of any Federal agency which has jurisdiction by law or special expertise with respect to any environmental impact involved. Copies of such statement and the comments and views of the appropriate Federal, State, and local agencies, which are authorized to develop and enforce environmental standards, shall be made available to the President, the Council on Environmental Quality and to the public as provided by section 552 of title 5, United States Code, and shall accompany the proposal through the existing agency review processes;

(D) study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources;

(E) recognize the worldwide and long-range character of environmental problems and, where consistent with the foreign policy of the United States, lend appropriate support to initiatives, resolutions, and programs designed to maximize international cooperation in anticipating and preventing a decline in the quality of mankind's world environment;

(F) make available to States, counties, municipalities, institutions, and individuals, advice and information useful in restoring, maintaining, and enhancing the quality of the environment;

(G) initiate and utilize ecological information in the planning and development of resource-oriented projects; and

(H) assist the Council on Environmental Quality established by title II of this Act.

Sec. 103. All agencies of the Federal Government shall review their present statutory authority, administrative regulations, and current policies and procedures for the purpose of determining whether there are any deficiencies or inconsistencies therein which prohibit full compliance with the purposes and provisions of this Act and shall propose to the President not later than July 1, 1971, such measures as may be necessary to bring their authority and policies into conformity with the intent, purposes, and procedures set forth in this Act.

Sec. 104. Nothing in section 102 or 103 shall in any way affect the specific statutory obligations of any Federal agency (1) to comply with criteria or standards of environmental quality, (2) to coordinate or consult with any other Federal or State agency, or (3) to act, or refrain from acting contingent upon the recommendations or certification of any other Federal or State agency.

Sec. 105. The policies and goals set forth in this Act are supplementary to those set forth in existing authorizations of Federal agencies.

TITLE II

COUNCIL ON ENVIRONMENTAL QUALITY

SEC. 201. The President shall transmit to the Congress annually beginning July 1, 1970, an Environmental Quality Report (hereinafter referred to as the "report") which shall set forth (1) the status and condition of the major natural, manmade, or altered environmental classes of the Nation, including, but not limited to, the air, the aquatic, including marine, estuarine, and fresh water, and the terrestrial environment, including, but not limited to, the forest, dryland, wetland, range, urban, suburban, and rural environment; (2) current and foreseeable trends in the quality, management and utilization of such environments and the effects of those trends on the social, economic, and other requirements of the Nation; (3) the adequacy of available natural resources for fulfilling human and economic requirements of the Nation in the light of expected population pressures; (4) a review of the programs and activities (including regulatory activities) of the Federal Government, the State and local governments, and nongovernmental entities or individuals, with particular reference to their effect on the environment and on the conservation, development and utilization of natural resources; and (5) a program for remedying the deficiencies of existing programs and activities, together with recommendations for legislation.

SEC. 202. There is created in the Executive Office of the President a Council on Environmental Quality (hereinafter referred to as the "Council"). The Council shall be composed of three members who shall be appointed by the President to serve at his pleasure, by and with the advice and consent of the Senate. The President shall designate one of the members of the Council to serve as Chairman. Each member shall be a person who, as a result of his training, experience, and attainments, is exceptionally well qualified to analyze and interpret environmental trends and information of all kinds; to appraise programs and activities of the Federal Government in the light of the policy set forth in title I of this Act; to be conscious of and responsive to the scientific, economic, social, esthetic, and cultural needs and interests of the Nation; and to formulate and recommend national policies to promote the improvement of the quality of the environment.

SEC. 203. The Council may employ such officers and employees as may be necessary to carry out its functions under this Act. In addition, the Council may employ and fix the compensation of such experts and consultants as may be necessary for the carrying out of its functions under this Act, in accordance with section 3109 of title 5, United States Code (but without regard to the last sentence thereof).

SEC. 204. It shall be the duty and function of the Council—

(1) to assist and advise the President in the preparation of the Environmental Quality Report required by section 201;

(2) to gather timely and authoritative information concerning the conditions and trends in the quality of the environment both current and prospective, to analyze and interpret such information for the purpose of determining whether such conditions and trends are interfering, or are likely to interfere, with the achievement of the policy set forth in title I of this Act, and to compile and submit to the President studies relating to such conditions and trends;

(3) to review and appraise the various programs and activities of the Federal Government in the light of the policy set forth in title I of this Act for the purpose of determining the extent to which such programs and activities are contributing to the achievement of such policy, and to make recommendations to the President with respect thereto;

(4) to develop and recommend to the President national policies to foster and promote the improvement of environmental quality to meet the conservation, social, economic, health, and other requirements and goals of the Nation;

(5) to conduct investigations, studies, surveys, research, and analyses relating to ecological systems and environmental quality;

(6) to document and define changes in the natural environment, including the plant and animal systems, and to accumulate necessary data and other information for a continuing analysis of these changes or trends and an interpretation of their underlying causes;

(7) to report at least once each year to the President on the state and condition of the environment; and

(8) to make and furnish such studies, reports thereon, and recommendations with respect to matters of policy and legislation as the President may request.

SEC. 205. In exercising its powers, functions, and duties under this Act, the Council shall—

(1) consult with the Citizens' Advisory Committee on Environmental Quality established by Executive Order numbered 11472, dated May 29, 1969, and with such representatives of science,

industry, agriculture, labor, conservation organizations, State and local governments and other groups, as it deems advisable; and

(2) utilize, to the fullest extent possible, the services, facilities, and information (including statistical information) of public and private agencies and organizations, and individuals, in order that duplication of effort and expense may be avoided, thus assuring that the Council's activities will not unnecessarily overlap or conflict with similar activities authorized by law and performed by established agencies.

Sec. 206. Members of the Council shall serve full time and the Chairman of the Council shall be compensated at the rate provided for Level II of the Executive Schedule Pay Rates (5 U.S.C. 5313). The other members of the Council shall be compensated at the rate provided for Level IV of the Executive Schedule Pay Rates (5 U.S.C. 5315).

Sec. 207. There are authorized to be appropriated to carry out the provisions of this Act not to exceed $300,000 for fiscal year 1970, $700,000 for fiscal year 1971, and $1,000,000 for each fiscal year thereafter.

Approved January 1, 1970.

APPENDIX B

Excerpts From President Nixon's State of the Union Address, January 22, 1970

I now turn to a subject which, next to our desire for peace, may well become the major concern of the American people in the decade of the seventies.

In the next ten years we shall increase our wealth by fifty percent. The profound question is—does this mean that we will be fifty percent richer in a real sense, fifty percent better off, fifty percent happier?

Or, does it mean that in the year 1980 the President standing in this place will look back on a decade in which seventy percent of our people lived in metropolitan areas choked by traffic, suffocated by smog, poisoned by water, deafened by noise and terrorized by crime?

These are not the great questions that concern world leaders at summit conferences. But people do not live at the summit. They live in the foothills of everyday experience. It is time for us all to concern ourselves with the way real people live in real life.

The great question of the seventies is, shall we surrender to our surroundings, or shall we make our peace with nature and begin to make reparations for the damage we have done to our air, our land and our water?

Restoring nature to its natural state is a cause beyond party and beyond factions. It has become a common cause of all the people of America. It is a cause of particular concern to young Americans—because they more than we will reap the grim consequences of our failure to act on programs which are needed now if we are to prevent disaster later.

Clean air, clean water, open spaces—these should once again be the birthright of every American. If we act now—they can be.

We still think of air as free. But clean air is not, and neither is clean water. The price tag on pollution control is high. Through our years of past carelessness we incurred a debt to nature, and now that debt is being called.

The program I shall propose to Congress will be the most comprehensive and costly program in this field ever in the nation's history.

It is not just a program for the next year. A year's plan in this field is no plan at all. This is a time to look ahead not a year, but five or ten years—whatever time is required to do the job.

I shall propose to this Congress a ten billion dollar nation-wide clean waters program to put modern municipal waste treatment plants in every place in America where they are needed to make our waters clean again, and to do it now.

We have the industrial capacity, if we begin now, to build them all within five years. This program will get them built within five years.

As our cities and suburbs relentlessly expand, those priceless open spaces needed for recreation areas accessible to their people are swallowed up—often forever. Unless we preserve these spaces while they are still available, we will have none to preserve. Therefore, I shall propose innovative financing methods for purchasing open space and park lands, now, before they are lost to us.

The automobile is our worst polluter of the air. Adequate control requires further advances in engine design and fuel composition. We shall intensify our research, set increasingly strict standards and strengthen enforcement procedures—and we shall do it now.

We no longer can afford to consider air and water common property, free to be abused by anyone without regard to the consequences. Instead, we should begin now to treat them as scarce resources, which we are no more free to contaminate than we are free to throw garbage in our neighbor's yard. This requires comprehensive new regulations. It also requires that, to the extent possible, the price of goods should be made to include the costs of producing and disposing of them without damage to the environment.

The argument is increasingly heard that a fundamental contradiction has arisen between economic growth and the quality of life, so that to have one we must forsake the other.

The answer is not to abandon growth, but to redirect it. For example, we should turn toward ending congestion and eliminating smog the same reservoir of inventive genius that created them in the first place.

Continued vigorous economic growth provides us with the means to enrich life itself and to enhance our planet as a place hospitable to man.

Each individual must enlist if this fight is to be won.

It has been said that no matter how many national parks and historical monuments we buy and develop, the truly significant environment for each of us is that in which we spend eighty percent of our time—that is, our homes, our places of work and the streets over which we pass.

Street litter, rundown parking strips and yards, dilapidated fences, broken windows, smoking automobiles, dingy working places, all should be the object of our fresh view.

We have been much too tolerant of our surroundings and too willing to leave it to others to clean up our environment. It is time for those who make massive demands on society to make some minimal demands on themselves. Each of us must resolve that each day he will leave his home, his property and the public places of his city or town a little cleaner, a little better, a little more pleasant for himself and those around him.

With the help of people we can do anything. Without their help we can do nothing. In this spirit, together, we can reclaim our land for ours and generations to come.

Between now and the year 2000, over one-hundred-million children will be born in the United States. Where they grow up—and how—will, more than any one thing, measure the quality of American life in these years ahead.

This should be a warning to us.

For the past thirty years our population has also been growing and shifting. The result is exemplified in the vast areas of rural America emptying out of people and of promise—a third of our counties lost population in the 1960s.

The violent and decayed central cities of our great metropolitan complexes are the most conspicuous area of failure in American life.

I propose that before these problems become insoluble, the nation develop a national growth policy. Our purpose will be to find those means by which Federal, state and local government can influence the course of urban settlement and growth so as positively to affect the quality of American life.

In the future, decisions as to where to build highways, locate airports, acquire land or sell land should be made with a clear objective of aiding a balanced growth.

In particular, the Federal government must be in a position to assist in the building of new cities and the rebuilding of old ones.

At the same time, we will carry our concern with the quality of life in America to the farm as well as the suburb, to the village as well as the city. What rural America most needs is a new kind of assistance. It needs to be dealt with, not as a separate nation, but as part of an overall growth policy for all America. We must create a new rural environment that will not only stem the migration to urban centers but reverse it.

If we seize our growth as a challenge, we can make the 1970s an historic period when by conscious choice we transformed our land into what we want it to become.

America, which has pioneered in the new abundance, and in the new technology, is called upon today to pioneer in meeting the concerns which have followed in their wake—in turning the wonders of science to the service of man. . . .

APPENDIX C

The President's Message on the Environment, February 10, 1970

To the Congress of the United States:

Like those in the last century who tilled a plot of land to exhaustion and then moved on to another, we in this century have too casually and too long abused our natural environment. The time has come when we can wait no longer to repair the damage already done, and to establish new criteria to guide us in the future.

The fight against pollution, however, is not a search for villains. For the most part, the damage done to our environment has not been the work of evil men, nor has it been the inevitable by-product either of advancing technology or of growing population. It results not so much from choices made, as from choices neglected: not from malign intention, but from failure to take into account the full consequences of our actions.

Quite inadvertently, by ignoring environmental costs we have given an economic advantage to the careless polluter over his more conscientious rival. While adopting laws prohibiting injury to person or property, we have freely allowed injury to our shared surroundings. Conditioned by an expanding frontier, we came only late to a recognition of how precious and how vulnerable our resources of land, water and air really are.

The tasks that need doing require money, resolve and ingenuity—and they are too big to be done by government alone. They call for fundamentally new philosophies of land, air and water use, for stricter regulation, for expanded government action, for greater citizen involvement, and for new programs to ensure that government, industry and individuals all are called on to do their share of the job and to pay their share of the cost.

Because the many aspects of environmental quality are closely interwoven, to consider each in isolation would be unwise. Therefore, I am today outlining a comprehensive, 37-point program, embracing 23 major legislative proposals and 14 new measures being taken by administrative action or Executive Order in five major categories:

—Water pollution control.
—Air pollution control.
—Solid waste management.
—Parklands and public recreation.
—Organizing for action.

As we deepen our understanding of complex ecological processes, as we improve our technologies and institutions and learn from experience, much more will be possible. But these 37 measures represent actions we can take *now*, and that can move us dramatically forward toward what has become an urgent common goal of all Americans: the rescue of our natural habitat as a place both habitable and hospitable to man.

WATER POLLUTION

Water pollution has three principal sources: municipal, industrial and agricultural wastes. All three must eventually be controlled if we are to restore the purity of our lakes and rivers.

Of these three, the most troublesome to control are those from agricultural sources: animal wastes, eroded soil, fertilizers and pesticides. Some of these are nature's own pollutions. The Missouri River was known as "Big Muddy" long before towns and industries were built on its banks. But many of the same techniques of pest control, livestock feeding, irrigation and soil fertilization that have made American agriculture so abundantly productive have also caused serious water pollution.

Effective control will take time, and will require action on many fronts: modified agricultural practices, greater care in the disposal of animal wastes, better soil conservation methods, new kinds of fertilizers, new chemical pesticides and more widespread use of natural pest control techniques. A number of such actions are already underway. We have taken action to phase out the use of DDT and other hard pesticides. We have begun to place controls on wastes from concentrated animal feed-lots. We need programs of intensified research, both public and private, to develop new methods of reducing agricultural pollution while maintaining productivity. I have asked The Council on Environmental Quality to press forward in this area. Meanwhile, however, we have the technology and the resources to proceed *now* on a program of swift clean-up of pollution from the most acutely damaging sources: municipal and industrial waste.

MUNICIPAL WASTES

As long as we have the means to do something about it, there is no good reason why municipal pollution of our waters should be allowed to persist unchecked.

In the four years since the Clean Waters Restoration Act of 1966 was passed, we have failed to keep our promises to ourselves: Federal appropriations for constructing municipal treatment plants have totaled only about one-third of authorizations. Municipalities themselves have faced increasing difficulty in selling bonds to finance their share of the construction costs. Given the saturated condition of today's municipal bond markets, if a clean-up program is to work it has to provide the means by which municipalities can finance their share of the cost even as we increase Federal expenditures.

The best current estimate is that it will take a total capital investment of about $10 billion over a five-year period to provide the municipal waste treatment plants and interceptor lines needed to meet our national water quality standards. This figure is based on a recently-completed nationwide survey of the deficiencies of present facilities, plus projections of additional needs that will have developed by then—to accommodate the normal annual increase in the volume of wastes, and to replace equipment that can be expected to wear out or become obsolete in the interim.

This will provide every community that needs it with secondary waste treatment, and also special, additional treatment in areas of special need, including communities on the Great Lakes. We have the industrial capacity to do the job in five years if we begin now.

To meet this construction schedule, I propose a two-part program of Federal assistance:

—I propose a Clean Waters Act with $4 billion to be authorized immediately, for Fiscal 1971, to cover the full Federal share of the total $10 billion cost on a matching fund basis. This would be allocated at a rate of $1 billion a year for the next four years,

with a reassessment in 1973 of needs for 1975 and subsequent years.

By thus assuring communities of full Federal support, we can enable planning to begin *now* for all needed facilities and construction to proceed at an accelerated rate.

—I propose creation of a new Environmental Financing Authority, to ensure that every municipality in the country has an opportunity to sell its waste treatment plant construction bonds.

The condition of the municipal bond market is such that, in 1969, 509 issues totaling $2.9 billion proved unsalable. If a municipality cannot sell waste treatment plant construction bonds, EFA will buy them and will sell its own bonds on the taxable market. Thus, construction of pollution control facilities will depend not on a community's credit rating, but on its waste disposal needs.

Providing money is important, but equally important is where and how the money is spent. A river cannot be polluted on its left bank and clean on its right. In a given waterway, abating *some* of the pollution is often little better than doing nothing at all, and money spent on such partial efforts is often largely wasted. Present grant allocation formulas—those in the 1966 Act—have prevented the spending of funds where they could produce the greatest results in terms of clean water. Too little attention has been given to seeing that investments in specific waste treatment plants have been matched by other municipalities and industries on the same waterway. Many plants have been poorly designed and inefficiently operated. Some municipalities have offered free treatment to local industries, then not treated their wastes sufficiently to prevent pollution.

To ensure that the new funds are well invested, five major reforms are needed. One requires legislation: the other four will be achieved by administrative action.

—I propose that the present, rigid allocation formula be revised, so that special emphasis can be given to areas where facilities are most needed and where the greatest improvements in water quality will result.

Under existing authority, the Secretary of the Interior will institute four major reforms:

—Federally assisted treatment plants will be required to meet prescribed design, operation and maintenance standards, and to be operated only by State-certified operators.

—Municipalities receiving Federal assistance in construction plants will be required to impose reasonable users' fees on industrial users sufficient to meet the costs of treating industrial wastes.

—Development of comprehensive river basin plans will be required at an early date, to ensure that Federally assisted treatment plants will in fact contribute to effective clean-up of entire river basin systems. Collection of existing data on pollution sources and development of effluent inventories will permit systems approaches to pollution control.

—Wherever feasible, communities will be strongly encouraged to cooperate in the construction of large regional treatment facilities, which provide economies of scale and give more efficient and more thorough waste treatment.

INDUSTRIAL POLLUTION

Some industries discharge their wastes into municipal systems; others discharge them directly into lakes and rivers. Obviously, unless we curb industrial as well as municipal pollution our waters will never be clean.

Industry itself has recognized the problem, and many industrial firms are making vigorous efforts to control their water-borne wastes. But strict standards and strict enforcement are nevertheless necessary—not only to ensure compliance, but also in fairness to those who have voluntarily assumed the often costly burden while their competitors have not. Good neighbors should not be placed at a competitive disadvantage because of their good neighborliness.

Under existing law, standards for water pollution control often are established in only the most general and insufficient terms: for example, by requiring all affected industries to install secondary treatment facilities. This approach takes little account of such crucial variables as the volume and toxicity of the wastes actually being discharged, or the capacity of a particular body of water to absorb wastes without becoming polluted. Even more important, it provides a poor basis for enforcement: with no effluent standard by which to measure, it is difficult to prove in court that standards are being violated.

The present fragmenting of jurisdictions also has hindered comprehensive efforts. At present, Federal jurisdiction generally extends only to interstate waters. One result has been that as stricter State-Federal standards have been imposed, pollution has actually increased in some other waters—in underground aquifers and the oceans. As controls over interstate waters are tightened, polluting industries will be increasingly tempted to locate on intrastate lakes and rivers—with a consequently increased threat to those waterways—unless they too are brought under the same strictures.

I propose that we take an entirely new approach: one which concerts Federal, State and private efforts, which provides for effective nationwide enforcement, and which rests on a simple but profoundly significant principle: that the nation's waterways belong to us all, and that neither a municipality nor an industry should be allowed to discharge wastes into those waterways beyond their capacity to absorb the wastes without becoming polluted.

Specifically, I propose a seven-point program of measures we should adopt *now* to enforce control of water pollution from industrial and municipal wastes, and to give the States more effective backing in their own efforts.

—I propose that State-Federal water quality standards be amended to impose precise effluent requirements on all industrial and municipal sources. These should be imposed on an expeditious timetable, with the limit for each based on a fair allocation of the total capacity of the waterway to absorb the user's particular kind of waste without becoming polluted.

—I propose that violation of established effluent requirements be considered sufficient cause for court action.

—I propose that the Secretary of the Interior be allowed to proceed more swiftly in his enforcement actions, and that he be given new legal weapons including subpoena and discovery power.

—I propose that failure to meet established water quality standards or implementation schedules be made subject to court-imposed fines of up to $10,000 per day.

—I propose that the Secretary of the Interior be authorized to seek immediate injunctive relief in emergency situations in which severe water pollution constitutes an imminent danger to health, or threatens irreversible damage to water quality.

—I propose that the Federal pollution-control program be extended to include all navigable waters, both inter- and intrastate, all interstate ground waters, the United States' portion of boundary waters, and waters of the Contiguous Zone.

—I propose that Federal operating grants to State pollution control enforcement agencies be tripled over the next five years—from $10 million now to $30 million in fiscal year 1975—to assist them in

meeting the new responsibilities that stricter and expanded enforcement will place upon them.

AIR POLLUTION CONTROL

Air is our most vital resource, and its pollution is our most serious environmental problem. Existing technology for the control of air pollution is less advanced than that for controlling water pollution, but there is a great deal we can do within the limits of existing technology—and more we can do to spur technological advance.

Most air pollution is produced by the burning of fuels. About half is produced by motor vehicles.

MOTOR VEHICLES

The Federal Government began regulating automobile emissions of carbon monoxide and hydrocarbons with the 1968 model year. Standards for 1970 model cars have been made significantly tighter. This year, for the first time, emissions from new buses and heavy-duty trucks have also been brought under Federal regulation.

In future years, emission levels can and must be brought much lower.

> *The Secretary of Health, Education and Welfare is today publishing a notice of new, considerably more stringent motor vehicle emission standards he intends to issue for 1973 and 1975 models including control of nitrogen oxides by 1973 and of particulate emissions by 1975.*

These new standards represent our best present estimate of the lowest emission levels attainable by those years.

Effective control requires new legislation to correct two key deficiencies in the present law:

(*a*) *Testing procedures.*—Under present law, only manufacturers' prototype vehicles are tested for compliance with emission standards, and even this is voluntary rather than mandatory.

> *I propose legislation requiring that representative samples of actual production vehicles be tested throughout the model year.*

(*b*) *Fuel composition and additives.*—What goes into a car's fuel has a major effect on what comes out of its exhaust, and also on what kinds of pollution-control devices can effectively be employed. Federal standards for what comes out of a car's engine should be accompanied by standards for what goes into it.

> *I propose legislation authorizing the Secretary of Health, Education and Welfare to regulate fuel composition and additives.*

With these changes, we can drastically reduce pollution from motor vehicles in the years just ahead. But in making and keeping our peace with nature, to plan only one year ahead or even five is hardly to plan at all. Our responsibility now is also to look beyond the Seventies, and the prospects then are uncertain. Based on present trends, it is quite possible that by 1980 the increase in the sheer number of cars in densely populated areas will begin outrunning the technological limits of our capacity to reduce pollution from the internal combustion engine. I hope this will not happen. I hope the automobile industry's presently determined effort to make the internal combustion engine sufficiently pollution-free succeeds. But if it does not, then unless motor vehicles with an alternative, low-pollution power source are available, vehicle-caused pollution will once again begin an inexorable increase.

Therefore, prudence dictates that we move now to ensure that such a vehicle will be available if needed.

I am inaugurating a program to marshal both government and private research with the goal of producing an unconventionally powered virtually pollution-free automobile within five years.

—*I have ordered the start of an extensive Federal research and development program in unconventional vehicles, to be conducted under the general direction of the Council on Environmental Quality.*

—*As an incentive to private developers, I have ordered that the Federal Government should undertake the purchase of privately produced unconventional vehicles for testing and evaluation.*

A proposal currently before the Congress would provide a further incentive to private developers by authorizing the Federal government to offer premium prices for purchasing low-pollution cars for its own use. This could be a highly productive program once such automobiles are approaching development, although current estimates are that, initially, prices offered would have to be up to 200% of the cost of equivalent conventional vehicles rather than the 125% contemplated in the proposed legislation. The immediate task, however, is to see that an intensified program of research and development begins at once.

One encouraging aspect of the effort to curb motor vehicle pollution is the extent to which industry itself is taking the initiative. For example, the nation's principal automobile manufacturers are not only developing devices now to meet present and future Federal emission standards, but are also, on their own initiative, preparing to put on the market by 1972 automobiles which will not require and, indeed, must not use leaded gasoline. Such cars will not only discharge no lead into the atmosphere, but will also be equipped with still more effective devices for controlling emissions—devices made possible by the use of lead-free gasoline.

This is a great forward step taken by the manufacturers before any Federal regulation of lead additives or emissions has been imposed. I am confident that the petroleum industry will see to it that suitable non-leaded gasoline is made widely available for these new cars when they come on the market.

STATIONARY-SOURCE POLLUTION

Industries, power plants, furnaces, incinerators—these and other so-called "stationary sources" add enormously to the pollution of the air. In highly industrialized areas, such pollution can quite literally make breathing hazardous to health, and can cause unforeseen atmospheric and meteorological problems as well.

Increasingly, industry itself has been adopting ambitious pollution-control programs, and state and local authorities have been setting and enforcing stricter anti-pollution standards. But they have not gone far enough or fast enough, nor, to be realistic about it, will they be able to without the strongest possible Federal backing. Without effective government standards, industrial firms that spend the necessary money for pollution control may find themselves at a serious economic disadvantage as against their less conscientious competitors. And without effective Federal standards, states and communities that require such controls find themselves at a similar disadvantage in attracting industry, against more permissive rivals. Air is no respecter of political boundaries: a community that sets and enforces strict standards may still find its air polluted from sources in another community or another state.

Under the Clean Air Act of 1967, the Federal government is establishing air quality control regions around the nation's major industrial and metropolitan areas. Within these regions, states are setting air quality standards—permissible levels of pollutants in the air—and developing plans for pollution abatement to achieve those air quality standards. All state air quality standards and implementation plans require Federal approval.

This program has been the first major Federal effort to control air pollution. It has been a useful beginning. But we have learned in the past two years that it has shortcomings. Federal designation of air quality control regions, while necessary in areas where emissions from one state are polluting the air in another, has been a time-consuming process. Adjoining states within the same region often have proposed inconsistent air quality standards, causing further delays for compromise and revision. There are no provisions for controlling pollution *outside* of established air quality control regions. This means that even with the designation of hundreds of such regions, some areas of the country with serious air pollution problems would remain outside of the program. This is unfair not only to the public but to many industries as well, since those within regions with strict requirements could be unfairly disadvantaged with respect to competitors that are not within regions. Finally, insufficient Federal enforcement powers have circumscribed the Federal government's ability to support the states in establishing and enforcing effective abatement programs.

It is time to build on what we have learned, and to begin a more ambitious national effort. I recommend that the Clean Air Act be revised to expand the scope of strict pollution abatement, to simplify the task of industry in pollution abatement through more nearly uniform standards, and to provide special controls against particularly dangerous pollutants.

—*I propose that the Federal government establish nationwide air quality standards, with the states to prepare within one year abatement plans for meeting those standards.*

This will provide a minimum standard for air quality for all areas of the nation, while permitting states to set more stringent standards for any or all sections within the state. National air quality standards will relieve the states of the lengthy process of standard-setting under Federal supervision, and allow them to concentrate on the immediate business of developing and implementing abatement plans.

These abatement plans would cover areas both inside and outside of Federally designated air quality control regions, and could be designed to achieve any higher levels of air quality which the states might choose to establish. They would include emission standards for stationary sources of air pollution.

—*I propose that designation of interstate air quality control regions continue at an accelerated rate, to provide a framework for establishing compatible abatement plans in interstate areas.*

—*I propose that the Federal government establish national emissions standards for facilities that emit pollutants extremely hazardous to health, and for selected classes of new facilities which could be major contributors to air pollution.*

In the first instance, national standards are needed to guarantee the earliest possible elimination of certain air pollutants which are clear health hazards even in minute quantities. In the second instance, national standards will ensure that advanced abatement technology is used in constructing the new facilities, and that levels of air quality are maintained in the face of industrial expansion. Before any emissions standards were established, public hearings would be required involving all interested parties. The States would be responsible for enforcing these standards in conjunction with their own programs.

—*I propose that Federal authority to seek court action be extended to include both inter- and intrastate air pollution situations in which, because of local non-enforcement, air quality is below national standards, or in which emissions standards or implementation timetables are being violated.*

—*I propose that failure to meet established air quality standards or implementation schedules be made subject to court-imposed fines of up to $10,000 per day.*

SOLID WASTE MANAGEMENT

"Solid wastes" are the discarded left-overs of our advanced consumer society. Increasing in volume, they litter the landscape and strain the facilities of municipal governments.

New packaging methods, using materials which do not degrade and cannot easily be burned, create difficult new disposal problems. Though many wastes are potentially re-usable, we often discard today what a generation ago we saved. Most bottles, for example, now are "non-returnable." We re-process used paper less than we used to, not only adding to the burden on municipal sanitation services but also making wasteful use of scarce timberlands. Often the least expensive way to dispose of an old automobile is to abandon it—and millions of people do precisely that, creating eyesores for millions of others.

One way to meet the problem of solid wastes is simply to surrender to it: to continue pouring more and more public money into collection and disposal of whatever happens to be privately produced and discarded. This is the old way; it amounts to a public subsidy of waste pollution. If we are ever truly to gain control of the problem, our goal must be broader: to reduce the volume of wastes and the difficulty of their disposal, and to encourage their constructive re-use instead.

To accomplish this, we need incentives, regulations and research directed especially at two major goals: a) making products more easily disposable—especially containers, which are designed for disposal; and b) re-using and recycling a far greater proportion of waste materials.

As we look toward the long-range future—to 1980, 2000 and beyond—recycling of materials will become increasingly necessary not only for waste disposal but also to conserve resources. While our population grows, each one of us keeps using more of the earth's resources. In the case of many common minerals, more than half those extracted from the earth since time began have been extracted since 1910.

A great deal of our space research has been directed toward creating self-sustaining environments, in which people can live for long periods of time by re-processing, re-cycling and re-using the same materials. We need to apply this kind of thinking more consciously and more broadly to our patterns of use and disposal of materials here on earth.

Many currently used techniques of solid waste disposal remain crudely deficient. Research and development programs under the Solid Waste Disposal Act of 1965 have added significantly to our knowledge of more efficient techniques. The Act expires this year. I recommend its extension, and I have already moved to broaden its programs.

> *I have ordered a re-direction of research under the Solid Waste Disposal Act to place greater emphasis on techniques for re-cycling materials, and on development and use of packaging and other materials which will degrade after use—that is, which will become temporary rather than permanent wastes.*

Few of America's eyesores are so unsightly as its millions of junk automobiles.

Ordinarily, when a car is retired from use it goes first to a wrecker, who strips it of its valuable parts, and then to a scrap processor, who reduces the remainder to scrap for sale to steel mills. The prices paid by wreckers for junk cars often are less than the cost of transporting them to the wrecking yard. In the case of a severely damaged or "cannibalized" car, instead of paying for it the wrecker may even charge towing costs. Thus the final owner's economic incentive to deliver his car for processing is slight, non-existent or even negative.

The rate of abandonment is increasing. In New York City, 2,500 cars were towed away as abandoned on the streets in 1960. In 1964, 25,000 were towed away as abandoned; in 1969, more than 50,000.

The way to provide the needed incentive is to apply to the automobile the principle that its price should include not only the cost of producing it, but also the cost of disposing of it.

> *I have asked the Council on Environmental Quality to take the lead in producing a recommendation for a bounty payment or other system to promote the prompt scrapping of all junk automobiles.*

The particular disposal problems presented by the automobile are unique. However, wherever appropriate we should also seek to establish incentives and regulations to encourage the re-use, re-cycling or easier disposal of other commonly used goods.

> *I have asked the Chairman of the Council on Environmental Quality to work with the Cabinet Committee on the Environment, and with appropriate industry and consumer representatives, toward development of such incentives and regulations for submission to the Congress.*

PARKS AND PUBLIC RECREATION

Increasing population, increasing mobility, increasing incomes and increasing leisure will all combine in the years ahead to rank recreational facilities among the most vital of our public resources. Yet land suitable for such facilities, especially near heavily populated areas, is being rapidly swallowed up.

Plain common sense argues that we give greater priority to acquiring now the lands that will be so greatly needed in a few years. Good sense also argues that the Federal Government itself, as the nation's largest landholder, should address itself more imaginatively to the question of making optimum use of its own holdings in a recreation-hungry era.

—*I propose full funding in fiscal 1971 of the $327 million available through the Land and Water Conservation Fund for additional park and recreational facilities, with increased emphasis on locations that can be easily reached by the people in crowded urban areas.*

—*I propose that we adopt a new philosophy for the use of Federally-owned lands, treating them as a precious resource—like money itself—which should be made to serve the highest possible public good.*

Acquiring needed recreation areas is a real estate transaction. One third of all the land in the United States—more than 750,000,000 acres—is owned by the Federal Government. Thousands of acres in the heart of metropolitan areas are reserved for only minimal use by Federal installations. To supplement the regularly-appropriated funds available, nothing could be more appropriate than to meet new real estate needs through use of presently-owned real estate, whether by transfer, sale or conversion to a better use.

Until now, the uses to which Federally-owned properties were put has largely been determined by who got them first. As a result, countless properties with enormous potential as recreational areas linger on in the hands of agencies that could just as well—or better—locate elsewhere. Bureaucratic inertia is compounded by a quirk of present accounting procedures, which has the effect of imposing a budgetary penalty on an agency that gives up one piece of property and moves to another, even if the vacated property is sold for 10 times the cost of the new.

The time has come to make more rational use of our enormous wealth of real property, giving a new priority to our newly urgent concern with public recreation—and to make more imaginative use of properties now surplus to finance acquisition of properties now needed.

—*By Executive Order, I am directing the heads of all Federal agencies and the Administrator of General Services to institute a review of all Federally-owned real properties that should be considered for other uses. The test will be whether a particular property's continued present use or another would better serve the public interest, considering both the agency's needs and the* *property's location. Special emphasis will be placed on identifying properties that could appropriately be converted to parks and recreation areas, or sold, so that proceeds can be made available to provide additional park and recreation lands.*

—*I am establishing a Property Review Board to review the GSA reports and recommend to me what properties should be converted or sold. This Board will consist of the Director of the Bureau of the Budget, the Chairman of the Council of Economic Advisers, the Chairman of the Council on Environmental Quality and the Administrator of General Services, plus others that I may designate.*

—*I propose legislation to establish, for the first time, a program for relocating Federal installations that occupy locations that could better be used for other purposes.*

This would allow a part of the proceeds from the sales of surplus properties to be used for relocating such installations, thus making more land available.

—*I also propose accompanying legislation to protect the Land and Water Conservation Fund, ensuring that its sources of income would be maintained and possibly increased for purchasing additional parkland.*

The net effect would be to increase our capacity to add new park and recreational facilities, by enabling us for the first time to use surplus property sales in a coordinated three-way program: a) by direct conversion from other uses; b) through sale of presently-owned properties and purchase of others with the proceeds; and c) by sale of one Federal property, and use of the proceeds to finance the relocation and conversion costs of making another property available for recreational use.

—*I propose that the Department of the Interior be given authority to convey surplus real property to State and local governments for park and recreation purposes at a public benefit discount ranging up to 100 percent.*

—*I propose that Federal procedures be revised to encourage Federal agencies to make efficient use of real property. This revision should remove the budgetary penalty now imposed on agencies relinquishing one site and moving to another.*

As one example of what such a property review can make possible, a sizable stretch of one of California's finest beaches has long been closed to the public because it was part of Camp Pendleton. Last month the Defense Department arranged to make more than a mile of that beach available to the State of California for use as a State park. The remaining beach is sufficient for Camp Pendleton's needs; thus the released stretch represents a shift from low-priority to high-priority use. By carefully weighing alternative uses, a priceless recreational resource was returned to the people for recreational purposes.

Another vast source of potential parklands also lies untapped. We have come to realize that we have too much land available for growing crops and not enough land for parks, open space and recreation.

—*I propose that instead of simply paying each year to keep this land idle, we help local governments buy selected parcels of it to provide recreational facilities for use by the people of towns in rural areas. This program has been tried, but allowed to lapse; I propose that we revive and expand it.*

—*I propose that we also adopt a program of long-term contracts with private owners of idled farmland, providing for its reforestation and public use for such pursuits as hunting, fishing, hiking and picknicking.*

Organizing for Action

The environmental problems we face are deep-rooted and widespread. They can be solved only by a full national effort embracing not only sound, coordinated planning, but also an effective follow-through that reaches into every community in the land. Improving our surroundings is necessarily the business of us all.

At the Federal level, we have begun the process of organizing for this effort.

The Council on Environmental Quality has been established. This Council will be the keeper of our environmental conscience, and a goad to our ingenuity; beyond this, it will have responsibility for ensuring that all our programs and actions are undertaken with a careful respect for the needs of environmental quality. I have already assigned it major responsibilities for new program development, and I shall look to it increasingly for new initiatives.

The Cabinet Committee on the Environment, which I created last year, acts as a coordinating agency for various departmental activities affecting the environment.

To meet future needs, many organizational changes will still be needed. Federal institutions for dealing with the environment and natural resources have developed piecemeal over the years in response to specific needs, not all of which were originally perceived in the light of the concerns we recognize today. Many of their missions appear to overlap, and even to conflict. Last year I asked the President's Advisory Council on Executive Organization, headed by Mr. Roy Ash, to make an especially thorough study of the organization of Federal environmental natural resource and oceanographic programs, and to report its recommendations to me by April 15. After receiving their report, I shall recommend needed reforms, which will involve major reassignments of responsibilities among Departments.

For many of the same reasons, overlaps in environmental programs extend to the Legislative as well as the Executive branch, so that close consultation will be necessary before major steps are taken.

No matter how well organized government itself might be, however, in the final analysis the key to success lies with the people of America.

Private industry has an especially crucial role. Its resources, its technology, its demonstrated ingenuity in solving problems others only talk about—all these are needed, not only in helping curb the pollution industry itself creates but also in helping devise new and better ways of enhancing all aspects of our environment.

> *I have ordered that the United States Patent Office give special priority to the processing of applications for patents which could aid in curbing environmental abuses.*

Industry already has begun moving swiftly toward a fuller recognition of its own environmental responsibilities, and has made substantial progress in many areas. However, more must be done.

Mobilizing industry's resources requires organization. With a remarkable degree of unanimity, its leaders have indicated their readiness to help.

> *I will shortly ask a group of the nation's principal industrial leaders to join me in establishing a National Industrial Pollution Control Council.*

The Council will work closely with the Council on Environmental Quality, the Citizens' Advisory Committee on Environmental Quality, the Secretary of Commerce and others as appropriate in the development of effective policies for the curbing of air, water, noise and waste pollution from industrial sources. It will work to enlist increased support from business and industry in the drive to reduce pollution, in all its forms, to the minimum level possible. It will provide a mechanism through which, in many cases, government can work with key leaders in various industries to establish voluntary programs for accomplishing desired pollution-control goals.

Patterns of organization often turn out to be only as good as the example set by the organizer. For years, many Federal facilities have themselves been among the worst polluters. The Executive Order I issued last week not only accepts responsibility for putting a swift end to Federal pollution, but puts teeth into the commitment.

I hope this will be an example for others.

At the turn of the century, our chief environmental concern was to conserve what we had—and out of this concern grew the often embattled but always determined "conservation" movement. Today, "conservation" is as important as ever—but no longer is it enough to conserve what we have; we must also restore what we have lost. We have to go beyond conservation to embrace restoration.

The task of cleaning up our environment calls for a total mobilization by all of us. It involves governments at every level; it requires the help of every citizen. It cannot be a matter of simply sitting back and blaming someone else. Neither is it one to be left to a few hundred leaders. Rather, it presents us with one of those rare situations in which each individual everywhere has an opportunity to make a special contribution to his country as well as his community.

Through the Council on Environmental Quality, through the Citizens' Advisory Committee on Environmental Quality, and working with Governors and Mayors and county officials and with concerned private groups, we shall be reaching out in an effort to enlist millions of helping hands, millions of willing spirits—millions of volunteer citizens who will put to themselves the simple question: "What can *I* do?"

It is in this way—with vigorous Federal leadership, with active enlistment of governments at every level, with the aid of industry and private groups, and above all with the determined participation by individual citizens in every state and every community, that we at last will succeed in restoring the kind of environment we want for ourselves, and the kind of generations that come after deserve to inherit.

This task is ours together. It summons our energy, our ingenuity and our conscience in a cause as fundamental as life itself.

RICHARD NIXON.

THE WHITE HOUSE.

APPENDIX D

Executive Order 11507, Prevention, Control, and Abatement of Air and Water Pollution at Federal Facilities, February 4, 1970

By virtue of the authority vested in me as President of the United States and in furtherance of the purpose and policy of the Clean Air Act, as amended (42 U.S.C. 1857), the Federal Water Pollution Control Act, as amended (33 U.S.C. 466), and the National Environmental Policy Act of 1969 (Public Law No. 91-190, approved January 1, 1970), it is ordered as follows:

SECTION 1. *Policy.* It is the intent of this order that the Federal Government in the design, operation, and maintenance of its facilities shall provide leadership in the nationwide effort to protect and enhance the quality of our air and water resources.

SEC. 2. *Definitions.* As used in this order:

(a) The term "respective Secretary" shall mean the Secretary of Health, Education, and Welfare in matters pertaining to air pollution control and the Secretary of the Interior in matters pertaining to water pollution control.

(b) The term "agencies" shall mean the departments, agencies, and establishments of the executive branch.

(c) The term "facilities" shall mean the buildings, installations, structures, public works, equipment, aircraft, vessels, and other vehicles and property, owned by or constructed or manufactured for the purpose of leasing to the Federal Government.

(d) The term "air and water quality standards" shall mean respectively the quality standards and related plans of implementation, including emission standards, adopted pursuant to the Clean Air Act, as amended, and the Federal Water Pollution Control Act, as amended, or as prescribed pursuant to section 4(b) of this order.

(e) The term "performance specifications" shall mean permissible limits of emissions, discharges, or other values applicable to a particular Federal facility that would, as a minimum, provide for conformance with air and water quality standards as defined herein.

(f) The term "United States" shall mean the fifty States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, and Guam.

SEC. 3. *Responsibilities.* (a) Heads of agencies shall, with regard to all facilities under their jurisdiction:

(1) Maintain review and surveillance to ensure that the standards set forth in section 4 of this order are met on a continuing basis.

(2) Direct particular attention to identifyinig potential air and water quality problems associated with the use and production of new materials and make provisions for their prevention and control.

(3) Consult with the respective Secretary concerning the best techniques and methods available for the protection and enhancement of air and water quality.

(4) Develop and publish procedures, within six months of the date of this order, to ensure that the facilities under their jurisdiction are in conformity with this order. In the preparation of such procedures there shall be timely and appropriate consultation with the respective Secretary.

(b) The respective Secretary shall provide leadership in implementing this order, including the provision of technical advice and assistance to the heads of agencies in connection with their duties and responsibilities under this order.

(c) The Council on Environmental Quality shall maintain continuing review of the implementation of this order and shall, from time to time, report to the President thereon.

SEC. 4. *Standards.* (a) Heads of agencies shall ensure that all facilities under their jurisdiction are designed, operated, and maintained so as to meet the following requirements:

(1) Facilities shall conform to air and water quality standards as defined in section 2(d) of this order. In those cases where no such air or water quality standards are in force for a particular geographical area, Federal facilities in that area shall conform to the standards established pursuant to subsection (b) of this

section. Federal facilities shall also conform to the performance specifications provided for in this order.

(2) Actions shall be taken to avoid or minimize wastes created through the complete cycle of operations of each facility.

(3) The use of municipal or regional waste collection or disposal systems shall be the preferred method of disposal of wastes from Federal facilities. Whenever use of such a system is not feasible or appropriate, the heads of agencies concerned shall take necessary measures for the satisfactory disposal of such wastes, including:

(A) When appropriate, the installation and operation of their own waste treatment and disposal facilities in a manner consistent with this section.

(B) The provision of trained manpower, laboratory and other supporting facilities as appropriate to meet the requirements of this section.

(C) The establishment of requirements that operators of Federal pollution control facilities meet levels of proficiency consistent with the operator certification requirements of the State in which the facility is located. In the absence of such State requirements the respective Secretary may issue guidelines, pertaining to operator qualifications and performance, for the use of heads of agencies.

(4) The use, storage, and handling of all materials, including but not limited to, solid fuels, ashes, petroleum products, and other chemical and biological agents, shall be carried out so as to avoid or minimize the possibilities for water and air pollution. When appropriate, preventive measures shall be taken to entrap spillage or discharge or otherwise to prevent accidental pollution. Each agency, in consultation with the respective Secretary, shall establish appropriate emergency plans and procedures for dealing with accidental pollution.

(5) No waste shall be disposed of or discharged in such a manner as could result in the pollution of ground water which would endanger the health or welfare of the public.

(6) Discharges of radioactivity shall be in accordance with the applicable rules, regulations, or requirements of the Atomic Energy Commission and with the policies and guidance of the Federal Radiation Council as published in the Federal Register.

(b) In those cases where there are no air or water quality standards as defined in section 2(d) of this order in force for a particular geographic area or in those cases where more stringent requirements are deemed advisable for Federal facilities, the respective Secretary, in consultation with appropriate Federal, State, interstate, and local agencies, may issue regulations establishing air or water quality standards for the purpose of this order, including related schedules for implementation.

(c) The heads of agencies, in consultation with the respective Secretary, may from time to time identify facilities or uses thereof which are to be exempted, including temporary relief, from provisions of this order in the interest of national security or in extraordinary cases where it is in the national interest. Such exemptions shall be reviewed periodically by the respective Secretary and the heads of the agencies concerned. A report on exemptions granted shall be submitted to the Council on Environmental Quality periodically.

SEC. 5. *Procedures for abatement of air and water pollution at existing Federal facilities.* (a) Actions necessary to meet the requirements of subsections (a)(1) and (b) of section 4 of this order pertaining to air and water pollution at existing facilities are to be completed or under way no later than December 31, 1972. In cases where an enforcement conference called pursuant to law or air and water quality standards require earlier actions, the earlier date shall be applicable.

(b) In order to ensure full compliance with the requirements of section 5(a) and to facilitate budgeting for necessary corrective and preventive measures, heads of agencies shall present to the Director of the Bureau of the Budget by June 30, 1970, a plan to provide for such improvements as may be necessary to meet the required date. Subsequent revisions needed to keep any such plan up-to-date shall be promptly submitted to the Director of the Bureau of the Budget.

(c) Heads of agencies shall notify the respective Secretary as to the performance specifications proposed for each facility to meet the requirements of subsections (a) (1) and (b) of section 4 of this order. Where the respective Secretary finds that such performance specifications are not adequate to meet such requirements, he shall consult with the agency head and the latter shall thereupon develop adequate performance specifications.

(d) As may be found necessary, heads of agencies may submit requests to the Director of the Bureau of the Budget for extensions of time for a project beyond the time specified in section 5(a). The

Director, in consultation with the respective Secretary, may approve such request if the Director deems that such project is not technically feasible or immediately necessary to meet the requirements of subsections 4 (a) and (b). Full justification as to the extraordinary circumstances necessitating any such extension shall be required.

(e) Heads of agencies shall not use for any other purpose any of the amounts appropriated and apportioned for corrective and preventive measures necessary to meet the requirements of subsection (a) for the fiscal year ending June 30, 1971, and for any subsequent fiscal year.

SEC. 6. *Procedures for new Federal facilities.* (a) Heads of agencies shall ensure that the requirements of section 4 of this order are considered at the earliest possible stage of planning for new facilities.

(b) A request for funds to defray the cost of designing and constructing new facilities in the United States shall be included in the annual budget estimates of an agency only if such request includes funds to defray the costs of such measures as may be necessary to assure that the new facility will meet the requirements of section 4 of this order.

(c) Heads of agencies shall notify the respective Secretary as to the performance specifications proposed for each facility when action is necessary to meet the requirements of subsections (a)(1) and (b) of section 4 of this order. Where the respective Secretary finds that such performance specifications are not adequate to meet such requirements he shall consult with the agency head and the latter shall thereupon develop adequate performance specifications.

(d) Heads of agencies shall give due consideration to the quality of air and water resources when facilities are constructed or operated outside the United States.

SEC. 7. *Procedures for Federal water resources projects.* (a) All water resources projects of the Departments of Agriculture, the Interior, and the Army, the Tennessee Valley Authority, and the United States Section of the International Boundary and Water Commission shall be consistent with the requirements of section 4 of this order. In addition, all such projects shall be presented for the consideration of the Secretary of the Interior at the earliest feasible stage if they involve proposals or recommendations with respect to the authorization or construction of any Federal water resources project in the United States. The Secretary of the Interior shall review plans and supporting data for all such projects relating to water quality, and shall prepare a report to the head of the responsible agency describing the potential impact of the project on water quality, including recommendations concerning any changes or other measures with respect thereto which he considers to be necessary in connection with the design, construction, and operation of the project.

(b) The report of the Secretary of the Interior shall accompany at the earliest practicable stage any report proposing authorization or construction, or a request for funding, of such a water resource project. In any case in which the Secretary of the Interior fails to submit a report within 90 days after receipt of project plans, the head of the agency concerned may propose authorization, construction, or funding of the project without such an accompanying report. In such a case, the head of the agency concerned shall explicitly state in his request or report concerning the project that the Secretary of the Interior has not reported on the potential impact of the project on water quality.

SEC. 8. *Saving provisions.* Except to the extent that they are inconsistent with this order, all outstanding rules, regulations, orders, delegations, or other forms of administrative action issued, made, or otherwise taken under the orders superseded by section 9 hereof or relating to the subject of this order shall remain in full force and effect until amended, modified, or terminated by proper authority.

SEC. 9. *Orders superseded.* Executive Order No. 11282 of May 26, 1966, and Executive Order No. 11288 of July 2, 1966, are hereby superseded.

RICHARD NIXON.

THE WHITE HOUSE.

APPENDIX E

Executive Order 11514, Protection and Enhancement of Environmental Quality, March 5, 1970

By virtue of the authority vested in me as President of the United States and in furtherance of the purpose and policy of the National Environmental Policy Act of 1969 (Public Law No. 91-190, approved January 1, 1970), it is ordered as follows:

SECTION 1. *Policy.* The Federal Government shall provide leadership in protecting and enhancing the quality of the Nation's environment to sustain and enrich human life. Federal agencies shall initiate measures needed to direct their policies, plans and programs so as to meet national environmental goals. The Council on Environmental Quality, through the Chairman, shall advise and assist the President in leading this national effort.

SEC. 2. *Responsibilities of Federal agencies.* Consonant with Title I of the National Environmental Policy Act of 1969, hereinafter referred to as the "Act", the heads of Federal agencies shall:

(a) Monitor, evaluate, and control on a continuing basis their agencies' activities so as to protect and enhance the quality of the environment. Such activities shall include those directed to controlling pollution and enhancing the environment and those designed to accomplish other program objectives which may affect the quality of the environment. Agencies shall develop programs and measures to protect and enhance environmental quality and shall assess progress in meeting the specific objectives of such activities. Heads of agencies shall consult with appropriate Federal, State and local agencies in carrying out their activities as they affect the quality of the environment.

(b) Develop procedures to ensure the fullest practicable provision of timely public information and understanding of Federal plans and programs with environmental impact in order to obtain the views of interested parties. These procedures shall include, whenever appropriate, provision for public hearings, and shall provide the public with relevant information, including information on alternative courses of action. Federal agencies shall also encourage State and local agencies to adopt similar procedures for informing the public concering their activities affecting the quality of the environment.

(c) Insure that information regarding existing or potential environmental problems and control methods developed as part of research, development, demonstration, test, or evaluation activities is made available to Federal agencies, States, counties, municipalities, institutions, and other entities, as appropriate.

(d) Review their agencies' statutory authority, administrative regulations, policies, and procedures, including those relating to loans, grants, contracts, leases, licenses, or permits, in order to identify any deficiencies or inconsistencies therein which prohibit or limit full compliance with the purposes and provisions of the Act. A report on this review and the corrective actions taken or planned, including such measures to be proposed to the President as may be necessary to bring their authority and policies into conformance with the intent, purposes, and procedures of the Act, shall be provided to the Council on Environmental Quality not later than September 1, 1970.

(e) Engage in exchange of data and research results, and cooperate with agencies of other governments to foster the purposes of the Act.

(f) Proceed, in coordination with other agencies, with actions required by section 102 of the Act.

SEC. 3. *Responsibilities of Council on Environmental Quality.* The Council on Environmental Quality shall:

(a) Evaluate existing and proposed policies and activities of the Federal Government directed to the control of pollution and the enhancement of the environment and to the accomplishment of other objectives which affect the quality of the environment. This shall include continuing review of procedures employed in the development and enforcement of Federal standards affecting environmental quality. Based upon such evaluations the Council shall, where appropriate, recommend to the President policies of environmental quality and shall, where appropriate, seek resolution of significant environmental issues.

(b) Recommend to the President and to the agencies priorities among programs designed for the control of pollution and for enhancement of the environment.

(c) Determine the need for new policies and programs for dealing with environmental problems not being adequately addressed.

(d) Conduct, as it determines to be appropriate, public hearings or conferences on issues of environmental significance.

(e) Promote the development and use of indices and monitoring systems (1) to assess environmental conditions and trends, (2) to predict the environmental impact of proposed public and private actions, and (3) to determine the effectiveness of programs of protecting and enhancing environmental quality.

(f) Coordinate Federal programs related to environmental quality.

(g) Advise and assist the President and the agencies in achieving international cooperation for dealing with environmental problems, under the foreign policy guidance of the Secretary of State.

(h) Issue guidelines to Federal agencies for the preparation of detailed statements on proposals for legislation and other Federal actions affecting the environment, as required by section 102(2)(C) of the Act.

(i) Issue such other instructions to agencies, and request such reports and other information from them, as may be required to carry out the Council's responsibilities under the Act.

(j) Assist the President in preparing the annual Environmental Quality Report provided for in section 201 of the Act.

(k) Foster investigations, studies, surveys, research, and analyses relating to (i) ecological systems and environmental quality, (ii) the impact of new and changing technologies thereon, and (iii) means of preventing or reducing adverse effects from such technologies.

SEC. 4. *Amendments of E. O. 11472.* Executive Order No. 11472 of May 29, 1969, including the heading thereof, is hereby amended:

(1) By substituting for the term "the Environmental Quality Council", wherever it occurs, the following: "the Cabinet Committee on the Environment".

(2) By substituting for the term "the Council", wherever it occurs, the following: "the Cabinet Committee".

(3) By inserting in subsection (f) of section 101, after "Budget,", the following: "the Director of the Office of Science and Technology,".

(4) By substituting for subsection (g) of section 101 the following:

"(g) The Chairman of the Council on Environmental Quality (established by Public Law 91–190) shall assist the President in directing the affairs of the Cabinet Committee."

(5) By deleting subsection (c) of section 102.

(6) By substituting for "the Office of Science and Technology", in section 104, the following: "the Council on Environmental Quality (established by Public Law 91–190)".

(7) By substituting for "(hereinafter referred to as the 'Committee')", in section 201, the following: "hereinafter referred to as the 'Citizens' Committee')".

(8) By substituting for the term "the Committee", wherever it occurs, the following: "the Citizens' Committee".

RICHARD NIXON.

THE WHITE HOUSE.

APPENDIX F

The Environmental Quality Improvement Act of 1970, Public Law 91-224, April 3, 1970

TITLE II—ENVIRONMENTAL QUALITY (OF THE WATER QUALITY IMPROVEMENT ACT OF 1970)

SHORT TITLE

SEC. 201. This title may be cited as the "Environmental Quality Improvement Act of 1970."

FINDINGS, DECLARATIONS, AND PURPOSES

SEC. 202. (a) The Congress finds—

(1) that man has caused changes in the environment;

(2) that many of these changes may affect the relationship between man and his environment; and

(3) that population increases and urban concentration contribute directly to pollution and the degradation of our environment.

(b) (1) The Congress declares that there is a national policy for the environment which provides for the enhancement of environmental quality. This policy is evidenced by statutes heretofore enacted relating to the prevention, abatement, and control of environmental pollution, water and land resources, transportation, and economic and regional development.

(2) The primary responsibility for implementing this policy rests with State and local governments.

(3) The Federal Government encourages and supports implementation of this policy through appropriate regional organizations established under existing law.

(c) The purposes of this title are—

(1) to assure that each Federal department and agency conducting or supporting public works activities which affect the environment shall implement the policies established under existing law; and

(2) to authorize an Office of Environmental Quality, which, notwithstanding any other provision of law, shall provide the professional and administrative staff for the Council on Environmental Quality established by Public Law 91–190.

OFFICE OF ENVIRONMENTAL QUALITY

SEC. 203. (a) There is established in the Executive Office of the President an office to be known as the Office of Environmental Quality (hereafter in this title referred to as the "Office"). The Chairman of the Council on Environmental Quality established by Public Law 91–190 shall be the Director of the Office. There shall be in the Office a Deputy Director who shall be appointed by the President, by and with the advice and consent of the Senate.

(b) The compensation of the Deputy Director shall be fixed by the President at a rate not in excess of the annual rate of compensation payable to the Deputy Director of the Bureau of the Budget.

(c) The Director is authorized to employ such officers and employees (including experts and consultants) as may be necessary to enable the Office to carry out its functions under this title and Public Law 91–190, except that he may employ no more than ten specialists and other experts without regard to the provisions of title 5, United States Code, governing appointments in the competitive service, and pay such specialists and experts without regard to the provisions of chapter 51 and subchapter 111 of chapter 53 of such title relating to classification and General Schedule pay rates, but no such specialist or expert shall be paid at a rate in excess of the maximum rate for GS–18 of the General Schedule under section 5330 of title 5.

(d) In carrying out his functions the Director shall assist and advise the President on policies and programs of the Federal Government affecting environmental quality by—

(1) providing the professional and administrative staff and support for the Council on Environmental Quality established by Public Law 91–190;

(2) assisting the Federal agencies and departments in appraising the effectiveness of existing and proposed facilities, programs, policies, and activities of the Federal Government, and those specific major projects designated by the President which do not require individual project authorization by Congress, which affect environmental quality;

(3) reviewing the adequacy of existing systems for monitoring and predicting environmental changes in order to achieve effective coverage and efficient use of research facilities and other resources;

(4) promoting the advancement of scientific knowledge of the effects of actions and technology on the environment and encourage the development of the means to prevent or reduce adverse effects that endanger the health and well-being of man;

(5) assisting in coordinating among the Federal departments and agencies those programs and activities which affect, protect, and improve environmental quality;

(6) assisting the Federal departments and agencies in the development and interrelationship of environmental quality criteria and standards established through the Federal Government;

(7) collecting, collating, analyzing, and interpreting data and information on environmental quality, ecological research, and evaluation.

(e) The Director is authorized to contract with public or private agencies, institutions, and organizations and with individuals without regard to sections 3618 and 3709 of the Revised Statutes (31 U.S.C. 529; 41 U.S.C. 5) in carrying out his functions.

REPORT

Sec. 204. Each Environmental Quality Report required by Public Law 91–190 shall, upon transmittal to Congress, be referred to each standing committee having jurisdiction over any part of the subject matter of the Report.

AUTHORIZATION

SEC. 205. There are hereby authorized to be appropriated not to exceed $500,000 for the fiscal year ending June 30, 1970, not to exceed $750,000 for the fiscal year ending June 30, 1971, not to exceed $1,250,000 for the fiscal year ending June 30, 1972, and not to exceed $1,500,000 for the fiscal year ending June 30, 1973. These authorizations are in addition to those contained in Public Law 91–190.

Approved April 3, 1970.

APPENDIX G

Council on Environmental Quality; Statements on Proposed Federal Actions Affecting the Environment; Interim Guidelines, April 30, 1970

1. *Purpose.* This memorandum provides interim guidelines to Federal departments, agencies and establishments for preparing detailed environmental statements on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, as required by section 102(2)(C) of the National Environmental Policy Act (Public Law 91–190) (hereafter "the Act"). Underlying the preparation of such environmental statements is the mandate of both the Act and Executive Order 11514 (35 F.R. 4247) of March 5, 1970, that all Federal agencies, to the fullest extent possible, direct their policies, plans and programs so as to meet national environmental goals.

2. *Policy.* Before undertaking major action or recommending or making a favorable report on legislation that significantly affects the environment, Federal agencies will, in consultation with other appropriate Federal, State, and local agencies, assess in detail the potential environmental impact in order that adverse affects are avoided, and environmental quality is restored or enhanced, to the fullest extent practicable. In particular, alternative actions that will minimize adverse impact should be explored and both the long- and short-range implications to man, his physical and social surroundings, and to nature, should be evaluated in order to avoid to the fullest extent practicable undesirable consequences for the environment.

3. *Agency and BOB procedures.* (a) Pursuant to section 2(f) of Executive Order 11514, the heads of Federal agencies have been directed to proceed with measures required by section 102(2)(C) of the Act. Consequently, each agency will establish no later than June 1, 1970, its own formal procedures for (1) identifying those agency actions requiring environmental statements, (2) obtaining information required in their preparation, (3) designating the officials who are to be responsible for the statements, (4) consulting with and taking account of the comments of appropriate Federal, State and local agencies, and (5) meeting the requirements of section 2(b) of Executive Order 11514 for providing timely public information on Federal plans and programs with environmental impact. These procedures should be consonant with the guidelines contained herein. Each agency should file seven (7) copies of all such procedures with the Council on Environmental Quality, which will provide advice to agencies in the preparation of their procedures and guidance on the application and interpretation of the Council's guidelines.

(b) Each Federal agency should consult, with the assistance of the Council on Environmental Quality if desired, with other appropriate Federal agencies in the development of the above procedures so as to achieve consistency in dealing with similar activities and to assure effective coordination among agencies in their review of proposed activities.

(c) It is imperative that existing mechanisms for obtaining the views of Federal, State, and local agencies on proposed Federal actions be utilized to the extent practicable in dealing with environmental matters. The Bureau of the Budget will issue instructions, as necessary, to take full advantage of existing mechanisms (relating to procedures for handling legislation, preparation of budgetary material, new policies and procedures, water resource and other projects, etc.).

4. *Federal agencies included.* Section 102(2)(C) applies to all agencies of the Federal Government with respect to recommendations or reports on proposals for (i) legislation and (ii) other major Federal actions significantly affecting the quality of the human environment. The phrase "to the fullest extent possible" in section 102(2)(C) is meant to make clear that each agency of the Federal Government shall comply with the requirement unless existing law applicable to the agency's operations expressly prohibits or makes compliance impossible. (Section 105 of the Act provides that "The policies and

goals set forth in this Act are supplementary to those set forth in existing authorizations of Federal agencies.")

5. *Actions included.* The following criteria will be employed by agencies in deciding whether a proposed action requires the preparation of an environmental statement:

(a) "Actions" include but not limited to:

(i) Recommendations or reports relating to legislation and appropriations;

(ii) Projects and continuing activities;

—Directly undertaken by Federal agencies;

—Supported in whole or in part through Federal contracts, grants, subsidies, loans, or other forms of funding assistance;

—Involving a Federal lease, permit, license, certificate or other entitlement for use;

(iii) Policy—and procedure-making.

(b) The statutory clause "major Federal actions significantly affecting the quality of the human environment" is to be construed by agencies with a view to the overall, cumulative impact of the action proposed (and of further actions contemplated). Such actions may be localized in their impact, but if there is potential that the environment may be significantly affected, the statement is to be prepared. Proposed actions the environmental impact of which is likely to be highly controversial should be covered in all cases. In considering what constitutes major action significantly affecting the environment, agencies should bear in mind that the effect of many Federal decisions about a project or complex of projects can be individually limited but cumulatively considerable. This can occur when one or more agencies over a period of years puts into a project individually minor but collectively major resources, when one decision involving a limited amount of money is a precedent for action in much larger cases or represents a decision in principle about a future major course of action, or when several Government agencies individually make decisions about partial aspects of a major action. The lead agency should prepare an environmental statement if it is reasonable to anticipate a cumulatively significant impact on the environment from the Federal action.

(c) Section 101(b) of the Act indicates the broad range of aspects of the environment to be surveyed in any assessment of significant effect. The Act also indicates that adverse significant effects include those that degrade the quality of the environment, curtail the range of beneficial uses of the environment or serve short-term, to the disadvantage of long-term, environmental goals. Significant effects can also include actions which may have both beneficial and detrimental effects, even if, on balance, the agency believes that the effect will be beneficial. Significant adverse effects on the quality of the human environment include both those that directly affect human beings and those that indirectly affect human beings through adverse effects on the environment.

(d) Because of the Act's legislative history, the regulatory activities of Federal environmental protection agencies (e.g., the Federal Water Quality Administration of the Department of the Interior and the National Air Pollution Control Administration of the Department of Health, Education, and Welfare) are not deemed actions which require the preparation of an environmental statement under section 102(2)(C) of the Act.

6. *Recommendations or reports on proposals for legislation.* The requirement for following the section 102(2)(C) procedure as elaborated in these guidelines applies to both (i) agency recommendations on their own proposals for legislation and (ii) agency reports on legislation initiated elsewhere. (In the latter case only the agency which has primary responsibility for the subject matter involved will prepare an environmental statement.) The Bureau of the Budget will supplement these general guidelines with specific instructions relating to the way in which the section 102(2)(C) procedure fits into its legislative clearance process.

7. *Content of environmental statement.* (a) The following points are to be covered:

(i) The probable impact of the proposed action on the environment, including impact on ecological systems such as wildlife, fish and marine life. Both primary and secondary significant consequences for the environment should be included in the analysis. For example, the implications, if any, of the action for population distribution or concentration should be estimated and an assessment made of the effect of any possible change in population patterns upon the resource base, including land use, water, and public services, of the area in question.

(ii) Any probable adverse environmental effects which cannot be avoided (such as water or air pollution, damage to life systems, urban congestion, threats to health or other consequences adverse to the environmental goals set out in section 101(b) of Public Law 91-190).

(iii) Alternatives to the proposed action (section 102(2)(D) of the Act requires the responsible agency to "study, develop and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources"). A rigorous exploration and objective evaluation of alternative actions that might avoid some or all of the adverse environmental effects is essential. Sufficient analysis of such alternatives and their costs and impact on the environment should accompany the proposed action through the agency review process in order not to foreclose prematurely options which might have less detrimental effects.

(iv) The relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity. This in essence requires the agency to assess the action for cumulative and long-term effects from the perspective that each generation is trustee of the environment for succeeding generations.

(v) Any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented. This requires the agency to identify the extent to which the action curtails the range of beneficial uses of the environment.

(vi) Where appropriate, a discussion of problems and objections raised by other Federal agencies and State and local entities in the review process and the disposition of the issues involved. (This section may be added at the end of the review process in the final text of the environmental statement.)

(b) With respect to water quality aspects of the proposed action which have been previously certified by the appropriate State or interstate organization as being in substantial compliance with applicable water quality standards, mere reference to the previous certification is sufficient.

(c) Each environmental statement should be prepared in accordance with the precept in section 102(2)(A) of the Act that all agencies of the Federal Government "utilize a systematic interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and decision making which may have an impact on man's environment."

8. *Federal agencies to be consulted in connection with preparation of environmental statement.* The Federal agencies to be consulted in connection with preparation of environmental statements are those which have "jurisdiction by law or special expertise with respect to any environmental impact involved" or "which are authorized to develop and enforce environmental standards". These Federal agencies include components of (depending on the aspect or aspects of the environment involved):

Department of Agriculture.
Department of Commerce.
Department of Defense.
Department of Health, Education, and Welfare.
Department of Housing and Urban Development.
Department of the Interior.
Department of Transportation.
Atomic Energy Commission.

For actions specially affecting the environment of their regional jurisdictions, the following Federal agencies are also to be consulted:

Tennessee Valley Authority.
Appalachian Regional Commission.

Agencies obtaining comment should determine which one or more of the above listed agencies are appropriate to consult. It is recommended that the above listed Departments establish contact points for providing comments and that Departments from which comment is solicited coordinate and consolidate the comments of their component entities. The requirement in section 102(2)(C) to obtain comment from Federal agencies having jurisdiction or special expertise is in addition to any specific statutory obligation of any Federal agency to coordinate or consult with any other Federal or State agency. Agencies seeking comment may establish time limits of not less than thirty days for reply, after which it may be presumed the agency consulted has no comment to make.

9. *State and local review.* Where no public hearing has been held on the proposed action at which the appropriate State and local review has been invited, and where review of the proposed action by State and local agencies authorized to develop and enforce environmental standards is relevant, such State and local review shall be provided for as follows:

(a) For direct Federal development projects and projects assisted under programs listed in Attachment D of the Bureau of the Budget Circular No. A–95, review by State and local governments will be through procedures set forth under Part 1 of Circular No. A–95.

(b) State and local review of agency procedures, regulations, and policies for the administration of Federal programs of assistance to State and local governments will be conducted pursuant to procedures established by Bureau of the Budget Circular No. A–85.

(c) Where these procedures are not appropriate and where the proposed action affects matters within their jurisdiction, review of the proposed action by State and local agencies authorized to develop and enforce environmental standards and their comments on the draft environmental statement may be obtained directly or by publication of a summary notice in the Federal Register (with a copy of the environmental statement and comments of Federal agencies thereon to be supplied on request). The notice in the Federal Register may specify that comments of the relevant State and local agencies must be submitted within 60 days of publication of the notice.

10. *Use of statements in agency review processes; distribution to Council on Environmental Quality.* (a) Agencies will need to identify at what stage or stages of a series of actions relating to a particular matter the environmental statement procedures of this directive will be applied. It will often be necessary to use the procedures both in the development of a national program and in the review of proposed projects within the national program. However, where a grant-in-aid program does not entail prior approval by Federal agencies of specific projects, the view of Federal, State, and local agencies in the legislative, and possibly appropriation, process may have to suffice. The principle to be applied is to obtain views of other agencies at the earliest feasible time in the development of program and project proposals. Care should be exercised so as not to duplicate the clearance process, but when actions being considered differ significantly from those that have already been reviewed an environmental statement should be provided.

(b) Seven (7) copies of draft environmental statements (when prepared), seven (7) copies of all comments received thereon (when received), and seven (7) copies of the final text of environmental statements should be supplied to the Council on Environmental Quality in the Executive Office of the President (this will serve as making environmental statements available to the President). It is important that draft environmental statements be prepared and circulated for comment and furnished to the Council early enough in the agency review process before an action is taken in order to permit meaningful consideration of the environmental issues involved.

11. *Application of section 102(2)(C) procedure to existing projects and programs.* To the fullest extent possible the section 102(2)(C) procedure should be applied to further major Federal actions having a significant effect on the environment even though they arise from projects or programs initiated prior to enactment of Public Law 91–190 on January 1, 1970. Where it is not practicable to reassess the basic

course of action, it is still important that further incremental major actions be shaped so as to minimize adverse environmental consequences. It is also important in further action that account be taken of environmental consequences not fully evaluated at the outset of the project or program.

12. *Availability of environmental statements and comments to public.* The agency which prepared the environmental statement is responsible for making such statement and the comments received available to the public pursuant to the provisions of the Freedom of Information Act (5 U.S.C. sec. 552).

13. *Review of existing authority, policies and procedures in light of National Environmental Policy Act.* Pursuant to section 103 of the Act and section 2(d) of Executive Order 11514, all agencies, as soon as possible, shall review their present statutory authority, administrative regulations, and current policies and procedures, including those relating to loans, grants, contracts, leases, licenses, certificates and permits, for the purpose of determining whether there are any deficiencies or inconsistencies therein which prohibit full compliance with the purposes and provisions of the Act. After such review each agency shall report to the Council on Environmental Quality not later than September 1, 1970, the results of such review and their proposals to bring their authority and policies into conformity with the intent, purposes and procedures set forth in the Act.

14. *Supplementary guidelines; evaluation of procedures.* (a) The Council on Environmental Quality after examining environmental statements and agency procedures with respect to such statements will issue such supplements to these guidelines as are necessary.

(b) Agencies will assess their experience in the implementation of the section 102(2)(C) provisions of the Act and in conforming with these guidelines and report thereon to the Council on Environmental Quality by December 1, 1970. Such reports should include an identification of problem areas and suggestions for revision or clarification of these guidelies to achieve effective coordination of views on environmental aspects (and alternatives, where appropriate) of proposed actions without imposing unproductive administrative procedures.

RUSSELL E. TRAIN,
Chairman.

[F.R. Doc. 70-5769; Filed, May 11, 1970; 8:46 a.m.]

APPENDIX H

Message of the President Relative to Reorganization Plans Nos. 3 and 4 of 1970, July 9, 1970

To the Congress of the United States:

As concern with the condition of our physical environment has intensified, it has become increasingly clear that we need to know more about the total environment—land, water and air. It also has become increasingly clear that only by reorganizing our Federal efforts can we develop that knowledge, and effectively ensure the protection, development and enhancement of the total environment itself.

The Government's environmentally-related activities have grown up piecemeal over the years. The time has come to organize them rationally and systematically. As a major step in this direction, I am transmitting today two reorganization plans: one to establish an Environmental Protection Agency, and one to establish, within the Department of Commerce, a National Oceanic and Atmospheric Administration.

ENVIRONMENTAL PROTECTION AGENCY (EPA)

Our national government today is not structured to make a coordinated attack on the pollutants which debase the air we breathe, the water we drink, and the land that grows our food. Indeed, the present governmental structure for dealing with environmental pollution often defies effective and concerted action.

Despite its complexity, for pollution control purposes the environment must be perceived as a single, interrelated system. Present assignments of departmental responsibilities do not reflect this interrelatedness.

Many agency missions, for example, are designed primarily along media lines—air, water, and land. Yet the sources of air, water, and land pollution are interrelated and often interchangeable. A single source may pollute the air with smoke and chemicals, the land with solid wastes, and a river or lake with chemical and other wastes. Control of the air pollution may produce more solid wastes, which then pollute the land or water. Control of the water-polluting effluent may convert it into solid wastes, which must be disposed of on land.

Similarly, some pollutants—chemicals, radiation, pesticides—appear in all media. Successful control of them at present requires the coordinated efforts of a variety of separate agencies and departments. The results are not always successful.

A far more effective approach to pollution control would:

—Identify pollutants.

—Trace them through the entire ecological chain, observing and recording changes in form as they occur.

—Determine the total exposure of man and his environment.

—Examine interactions among forms of pollution.

—Identify where in the ecological chain interdiction would be most appropriate.

In organizational terms, this requires pulling together into one agency a variety of research, monitoring, standard-setting and enforcement activities now scattered through several departments and agencies. It also requires that the new agency include sufficient support elements—in research and in aids to State and local anti-pollution programs, for example—to give it the needed strength and potential for carrying out its mission. The new agency would also, of course, draw upon the results of research conducted by other agencies.

Components of the EPA

Under the terms of Reorganization Plan No. 3, the following would be moved to the new Environmental Protection Agency:

—The functions carried out by the Federal Water Quality Administration (from the Department of the Interior).

—Functions with respect to pesticides studies now vested in the Department of the Interior.

—The functions carried out by the National Air Pollution Control Administration (from the Department of Health, Education, and Welfare).

—The functions carried out by the Bureau of Solid Waste Management and the Bureau of Water Hygiene, and portions of the functions carried out by the Bureau of Radiological Health of the Environmental Control Administration (from the Department of Health, Education and Welfare).

—Certain functions with respect to pesticides carried out by the Food and Drug Administration (from the Department of Health, Education and Welfare).

—Authority to perform studies relating to ecological systems now vested in the Council on Environmental Quality.

—Certain functions respecting radiation criteria and standards now vested in the Atomic Energy Commission and the Federal Radiation Council.

—Functions respecting pesticides registration and related activities now carried out by the Agricultural Research Service (from the Department of Agriculture).

With its broad mandate, EPA would also develop competence in areas of environmental protection that have not previously been given enough attention, such, for example, as the problem of noise, and it would provide an organization to which new programs in these areas could be added.

In brief, these are the principal functions to be transferred:

Federal Water Quality Administration.—Charged with the control of pollutants which impair water quality, it is broadly concerned with the impact of degraded water quality. It performs a wide variety of functions, including research, standard-setting and enforcement, and provides construction grants and technical assistance.

Certain pesticides research authority from the Department of the Interior.—Authority for research on the effects of pesticides on fish and wildlife would be provided to the EPA through transfer of the specialized research authority of the pesticides act enacted in 1958. Interior would retain its responsibility to do research on all factors affecting fish and wildlife. Under this provision, only one laboratory would be transferred to the EPA—the Gulf Breeze Biological Laboratory of the Bureau of Commercial Fisheries. The EPA would work closely with the fish and wildlife laboratories remaining with the Bureau of Sport Fisheries and Wildlife.

National Air Pollution Control Administration.—As the principal Federal agency concerned with air pollution, it conducts research on the effects of air pollution, operates a monitoring network, and promulgates criteria which serve as the basis for setting air quality standards. Its regulatory functions are similar to those of the Federal Water Quality Administration. NAPCA is responsible for administering the Clean Air Act, which involves designating air quality regions, approving State standards, and providing financial and technical assistance to State Control agencies to enable them to comply with the Act's provisions. It also sets and enforces Federal automotive emission standards.

Elements of the Environmental Control Administration.—ECA is the focal point within HEW for evaluation and control of a broad range of environmental health problems, including water quality, solid wastes, and radiation. Programs in the ECA involve research, development of criteria and standards, and the administration of planning and demonstration grants. From the ECA, the activities of the Bureaus of Water Hygiene and Solid Waste Management and portions of the activities of the Bureau of Radiological Health would be transferred. Other functions of the ECA including those related to the regulation of radiation from consumer products and occupational safety and health would remain in HEW.

Pesticides research and standard-setting programs of the Food and Drug Administration.—FDA's pesticides program consists of setting and enforcing standards which limit pesticide residues in food. EPA would have the authority to set pesticide standards and to monitor compliance with them, as well as to conduct related research. However, as an integral part of its food protection activities, FDA would retain its authority to remove from the market food with excess pesticide residues.

General ecological research from the Council on Environmental Quality.—This authority to perform studies and research relating to ecological systems would be in addition to EPA's other specific research authorities, and it would help EPA to measure the impact of pollutants. The Council on Environmental Quality would retain its authority to conduct studies and research relating to environmental quality.

Environmental radiation standards programs.—The Atomic Energy Commission is now responsible for establishing environmental radiation standards and emission limits for radioactivity. Those standards have been based largely on broad guidelines recommended by the

Federal Radiation Council. The Atomic Energy Commission's authority to set standards for the protection of the general environment from radioactive material would be transferred to the Environmental Protection Agency. The functions of the Federal Radiation Council would also be transferred. AEC would retain responsibility for the implementation and enforcement of radiation standards through its licensing authority.

Pesticides registration program of the Agricultural Research Service.--The Department of Agriculture is currently responsible for several distinct functions related to pesticides use. It conducts research on the efficacy of various pesticides as related to other pest control methods and on the effects of pesticides on non-target plants, livestock, and poultry. It registers pesticides, monitors their persistence and carries out an educational program on pesticide use through the extension service. It conducts extensive pest control programs which utilize pesticides.

By transferring the Department of Agriculture's pesticides registration and monitoring function to the EPA and merging it with the pesticides programs being transferred from HEW and Interior, the new agency would be given a broad capability for control over the introduction of pesticides into the environment.

The Department of Agriculture would continue to conduct research on the effectiveness of pesticides. The Department would furnish this information to the EPA, which would have the responsibility for actually licensing pesticides for use after considering environmental and health effects. Thus the new agency would be able to make use of the expertise of the Department.

Advantages of Reorganization

This reorganization would permit response to environmental problems in a manner beyond the previous capability of our pollution control programs. The EPA would have the capacity to do research on important pollutants irrespective of the media in which they appear, and on the impact of these pollutants on the total environment. Both by itself and together with other agencies, the EPA would monitor the condition of the environment—biological as well as physical. With these data, the EPA would be able to establish quantitative "environmental baselines"—critical if we are to measure adequately the success or failure of our pollution abatement efforts.

As no disjointed array of separate programs can, the EPA would be able—in concert with the States—to set and enforce standards for air and water quality and for individual pollutants. This consolidation of pollution control authorities would help assure that we do not create new environmental problems in the process of controlling existing ones. Industries seeking to minimize the adverse impact of their activities on the environment would be assured of consistent standards covering the full range of their waste disposal problems. As the States develop and expand their own pollution control programs, they would be able to look to one agency to support their efforts with financial and technical assistance and training.

In proposing that the Environmental Protection Agency be set up as a separate new agency, I am making an exception to one of my own principles: that, as a matter of effective and orderly administration, additional new independent agencies normally should not be created. In this case, however, the arguments against placing environmental protection activities under the jurisdiction of one or another of the existing departments and agencies are compelling.

In the first place, almost every part of government is concerned with the environment in some way, and affects it in some way. Yet each department also has its own primary mission—such as resource development, transportation, health, defense, urban growth or agriculture—which necessarily affects its own view of environmental questions.

In the second place, if the critical standard-setting functions were centralized within any one existing department, it would require that department constantly to make decisions affecting other departments—in which, whether fairly or unfairly, its own objectivity as an impartial arbiter could be called into question.

Because environmental protection cuts across so many jurisdictions, and because arresting environmental deterioration is of great importance to the quality of life in our country and the world, I believe that in this case a strong, independent agency is needed. That agency would, of course, work closely with and draw upon the expertise and assistance of other agencies having experience in the environmental area.

Roles and Functions of EPA

The principal roles and functions of the EPA would include:

- —The establishment and enforcement of environmental protection standards consistent with national environmental goals.

—The conduct of research on the adverse effects of pollution and on methods and equipment for controlling it, the gathering of information on pollution, and the use of this information in strengthening environmental protection programs and recommending policy changes.

—Assisting others, through grants, technical assistance and other means in arresting pollution of the environment.

—Assisting the Council on Environmental Quality in developing and recommending to the President new policies for the protection of the environment.

One natural question concerns the relationship between the EPA and the Council on Environmental Quality recently established by Act of Congress.

It is my intention and expectation that the two will work in close harmony, reinforcing each other's mission. Essentially, the Council is a top-level advisory group (which might be compared with the Council of Economic Advisers), while the EPA would be an operating, "line" organization. The Council will continue to be a part of the Executive Office of the President and will perform its overall coordinating and advisory roles with respect to all Federal programs related to environmental quality.

The Council, then, is concerned with all aspects of environmental quality—wildlife preservation, parklands, land use, and population growth, as well as pollution. The EPA would be charged with protecting the environment by abating pollution. In short, the Council focuses on what our broad policies in the environmental field should be; the EPA would focus on setting and enforcing pollution control standards. The two are not competing, but complementary—and taken together, they should give us, for the first time, the means to mount an effectively coordinated campaign against environmental degradation in all of its many forms.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

The oceans and the atmosphere are interacting parts of the total environmental system upon which we depend not only for the quality of our lives, but for life itself.

We face immediate and compelling needs for better protection of life and property from natural hazards, and for a better understanding of the total environment—an understanding which will enable us more effectively to monitor and predict its actions, and ultimately, perhaps to exercise some degree of control over them.

We also face a compelling need for exploration and development leading to the intelligent use of our marine resources. The global oceans, which constitute nearly three-fourths of the surface of our planet, are today the least-understood, the least-developed, and the least-protected part of our earth. Food from the oceans will increasingly be a key element in the world's fight against hunger. The mineral resources of the ocean beds and of the oceans themselves, are being increasingly tapped to meet the growing world demand. We must understand the nature of these resources, and assure their development without either contaminating the marine environment or upsetting its balance.

Establishment of the National Oceanic and Atmospheric Administration—NOAA—within the Department of Commerce would enable us to approach these tasks in a coordinated way. By employing a unified approach to the problems of the oceans and atmosphere, we can increase our knowledge and expand our opportunities not only in those areas, but in the third major component of our environment, the solid earth, as well.

Scattered through various Federal departments and agencies, we already have the scientific, technological, and administrative resources to make an effective, unified approach possible. What we need is to bring them together. Establishment of NOAA would do so.

By far the largest of the components being merged would be the Commerce Department's Environmental Science Services Administration (ESSA), with some 10,000 employees (70 percent of NOAA's total personnel strength) and estimated Fiscal 1970 expenditures of almost $200 million. Placing NOAA within the Department of Commerce therefore entails the least dislocation, while also placing it within a Department which has traditionally been a center for service activities in the scientific and technological area.

Components of NOAA

Under terms of Reorganization Plan No. 4, the programs of the following organizations would be moved into NOAA:

—The Environmental Science Services Administration (from within the Department of Commerce).

—Elements of the Bureau of Commercial Fisheries (from the Department of the Interior).

—The marine sport fish program of the Bureau of Sport Fisheries and Wildlife (from the Department of the Interior).

—The Marine Minerals Technology Center of the Bureau of Mines (from the Department of the Interior).

—The Office of Sea Grant Programs (from the National Science Foundation).

—Elements of the United States Lake Survey (from the Department of the Army).

In addition, by executive action, the programs of the following organizations would be transferred to NOAA:

—The National Oceanographic Data Center (from the Department of the Navy).

—The National Oceanographic Instrumentation Center (from the Department of the Navy).

—The National Data Buoy Project (from the Department of Transportation).

In brief, these are the principal functions of the programs and agencies to be combined:

THE ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION

(*ESSA*) comprises the following components:

—The Weather Bureau (weather, marine, river and flood forecasting and warning).

—The Coast and Geodetic Survey (earth and marine description, mapping and charting).

—The Environmental Data Service (storage and retrieval of environmental data).

—The National Environmental Satellite Center (observation of the global environment from earth-orbiting satellites).

—The ESSA Research Laboratories (research on physical environmental problems).

ESSA's activities include observing and predicting the state of the oceans, the state of the lower and upper atmosphere, and the size and shape of the earth. It maintains the nation's warning systems for such natural hazards as hurricanes, tornadoes, floods, earthquakes and seismic sea waves. It provides information for national defense, agriculture, transportation and industry.

ESSA monitors atmospheric, oceanic and geophysical phenomena on a global basis, through an unparalleled complex of air, ocean, earth and space facilities. It also prepares aeronautical and marine maps and charts.

Bureau of Commercial Fisheries and marine sport fish activities.—Those fishery activities of the Department of the Interior's U.S. Fish and Wildlife Service which are ocean related and those which are directed toward commercial fishing would be transferred. The Fish and Wildlife Service's Bureau of Commercial Fisheries has the dual function of strengthening the fishing industry and promoting conservation of fishery stocks. It conducts research on important marine species and on fundamental oceanography, and operates a fleet of oceanographic vessels and a number of laboratories. Most of its activities would be transferred. From the Fish and Wildlife Service's Bureau of Sport Fisheries and Wildlife, the marine sport fishing program would be transferred. This involves five supporting laboratories and three ships engaged in activities to enhance marine sport fishing opportunities.

The Marine Minerals Technology Center is concerned with the development of marine mining technology.

Office of Sea Grant Programs.—The Sea Grant Program was authorized in 1966 to permit the Federal Government to assist the academic and industrial communities in developing marine resources and technology. It aims at strengthening education and training of marine specialists, supporting applied research in the recovery and use of marine resources, and developing extension and advisory services. The Office carries out these objectives by making grants to selected academic institutions.

The U.S. Lake Survey has two primary missions. It prepares and publishes navigation charts of the Great Lakes and tributary waters and conducts research on a variety of hydraulic and hydrologic phenomena of the Great Lakes' waters. Its activities are very similar to those conducted along the Atlantic and Pacific coasts by ESSA's Coast and Geodetic Survey.

The National Oceanographic Data Center is responsible for the collection and dissemination of oceanographic data accumulated by all Federal agencies.

The National Oceanographic Instrumentation Center provides a central Federal service for the calibration and testing of oceanographic instruments.

The National Data Buoy Development Project was established to determine the feasibility of deploying a system of automatic ocean buoys to obtain oceanic and atmospheric data.

Role of NOAA

Drawing these activities together into a single agency would make possible a balanced Federal program to improve our understanding of the resources of the sea, and permit their development and use while guarding against the sort of thoughtless exploitation that in the past laid waste to so many of our precious natural assets. It would make possible a consolidated program for achieving a more comprehensive understanding of oceanic and atmospheric phenomena, which so greatly affect our lives and activities. It would facilitate the cooperation between public and private interests that can best serve the interests of all.

I expect that NOAA would exercise leadership in developing a national oceanic and atmospheric program of research and development. It would coordinate its own scientific and technical resources with the technical and operational capabilities of other government agencies and private institutions. As important, NOAA would continue to provide those services to other agencies of government, industry and private individuals which have become essential to the efficient operation of our transportation systems, our agriculture and our national security. I expect it to maintain continuing and close liaison with the new Environmental Protection Agency and the Council on Environmental Quality as part of an effort to ensure that environmental questions are dealt with in their totality and that they benefit from the full range of the government's technical and human resources.

Authorities who have studied this matter, including the Commission on Marine Science, Engineering and Resources, strongly recommended the creation of a National Advisory Committee for the Oceans. I agree. Consequently, I will request, upon approval of the plan, that the Secretary of Commerce establish a National Advisory Committee for the Oceans and the Atmosphere to advise him on the progress of governmental and private programs in achieving the nation's oceanic and atmospheric objectives.

AN ON-GOING PROCESS

The reorganizations which I am here proposing afford both the Congress and the Executive Branch an opportunity to re-evaluate the adequacy of existing program authorities involved in these consolidations. As these two new organizations come into being, we may well find that supplementary legislation to perfect their authorities will be necessary. I look forward to working with the Congress in this task.

In formulating these reorganization plans, I have been greatly aided by the work of the President's Advisory Council on Executive Organization (the Ash Council), the Commission on Marine Science, Engineering and Resources (the Stratton Commission, appointed by President Johnson), my special task force on oceanography headed by Dr. James Wakelin, and by the information developed during both House and Senate hearings on proposed NOAA legislation.

Many of those who have advised me have proposed additional reorganizations, and it may well be that in the future I shall recommend further changes. For the present, however, I think the two reorganizations transmitted today represent a sound and significant beginning. I also think that in practical terms, in this sensitive and rapidly developing area, it is better to proceed a step at a time—and thus to be sure that we are not caught up in a form of organizational indigestion from trying to rearrange too much at once. As we see how these changes work out, we will gain a better understanding of what further changes—in addition to these—might be desirable.

Ultimately, our objective should be to insure that the nation's environmental and resource protection activities are so organized as to maximize both the effective coordination of all and the effective functioning of each.

The Congress, the Administration and the public all share a profound commitment to the rescue of our natural environment, and the preservation of the Earth as a place both habitable by and hospitable to man. With its acceptance of these reorganization plans, the Congress will help us fulfill that commitment.

RICHARD NIXON.

THE WHITE HOUSE.

APPENDIX I

Message of the President Transmitting Reorganization Plan No. 3 of 1970, July 9, 1970

To the Congress of the United States:

I transmit herewith Reorganization Plan No. 3 of 1970, prepared in accordance with chapter 9 of title 5 of the United States Code and providing for an Environmental Protection Agency. My reasons for transmitting this plan are stated in a more extended accompanying message.

After investigation, I have found and hereby declare that each reorganization included in Reorganization Plan No. 3 of 1970 is necessary to accomplish one or more of the purposes set forth in section 901(a) of title 5 of the United States Code. In particular, the plan is responsive to section 901(a)(1), "to promote the better execution of the laws, the more effective management of the executive branch and of its agencies and functions, and the expeditious administration of the public business;" and section 901(a)(3), "to increase the efficiency of the operations of the Government to the fullest extent practicable."

The reorganizations provided for in the plan make necessary the appointment and compensation of new officers as specified in section 1 of the plan. The rates of compensation fixed for these officers are comparable to those fixed for other officers in the executive branch who have similar responsibilities.

Section 907 of title 5 of the United States Code will operate to preserve administrative proceedings, including any public hearing proceedings, related to the transferred functions, which are pending immediately prior to the taking effect of the reorganization plan.

The reorganization plan should result in more efficient operation of the Government. It is not practical, however, to itemize or aggregate the exact expenditure reductions which will result from this action.

RICHARD NIXON.

THE WHITE HOUSE.

REORGANIZATION PLAN NO. 3 OF 1970

Prepared by the President and transmitted to the Senate and the House of Representatives in Congress assembled, July 9, 1970, pursuant to the provisions of chapter 9 of title 5 of the United States Code

ENVIRONMENTAL PROTECTION AGENCY

SECTION 1. *Establishment of Agency.* (a) There is hereby established the Environmental Protection Agency, hereinafter referred to as the "Agency."

(b) There shall be at the head of the Agency the Administrator of the Environmental Protection Agency, hereinafter referred to as the "Administrator." The Administrator shall be appointed by the President, by and with the advice and consent of the Senate, and shall be compensated at the rate now or hereafter provided for Level II of the Executive Schedule Pay Rates (5 U.S.C. 5313).

(c) There shall be in the Agency a Deputy Administrator of the Environmental Protection Agency who shall be appointed by the President. by and with the advice and consent of the Senate, and shall be compensated at the rate now or hereafter provided for Level III of the Executive Schedule Pay Rates (5 U.S.C. 5314). The Deputy Administrator shall perform such functions as the Administrator shall from time to time assign or delegate, and shall act as Administrator during the absence or disability of the Administrator or in the event of a vacancy in the office of Administrator.

(d) There shall be in the Agency not to exceed five Assistant Administrators of the Environmental Protection Agency who shall be appointed by the President, by and with the advice and consent of the Senate, and shall be compensated at the rate now or hereafter provided for Level IV of the Executive Schedule Pay Rates (5 U.S.C. 5315). Each Assistant Administrator shall perform such functions as the Administrator shall from time to time assign or delegate.

SEC. 2. *Transfers to Environmental Protection Agency.* (a) There are hereby transferred to the Administrator:

(1) All functions vested by law in the Secretary of the Interior and the Department of the Interior which are administered through the Federal Water Quality Administration, all functions which were transferred to the Secretary of the Interior by Reorganization Plan No. 2 of 1966 (80 Stat. 1608), and all functions vested in the Secretary

of the Interior or the Department of the Interior by the Federal Water Pollution Control Act or by provisions of law amendatory or supplementary thereof.

(2)(i) The functions vested in the Secretary of the Interior by the Act of August 1, 1958, 72 Stat. 479, 16 U.S.C. 742d-1 (being an Act relating to studies on the effects of insecticides, herbicides, fungicides, and pesticides upon the fish and wildlife resources of the United States), and (ii) the functions vested by law in the Secretary of the Interior and the Department of the Interior which are administered by the Gulf Breeze Biological Laboratory of the Bureau of Commercial Fisheries at Gulf Breeze, Florida.

(3) The functions vested by law in the Secretary of Health, Education, and Welfare or in the Department of Health, Education, and Welfare which are administered through he Environmental Health Service, including the functions exercised by the following components thereof:

- (i) The National Air Pollution Control Administration,
- (ii) The Environmental Control Administration:
  - (A) Bureau of Solid Waste Management,
  - (B) Bureau of Water Hygiene,
  - (C) Bureau of Radiological Health,

except that functions carried out by the following components of the Environmental Control Administration of the Environmental Health Service are not transferred: (i) Bureau of Community Environmental Management, (ii) Bureau of Occupational Safety and Health, and (iii) Bureau of Radiological Health, insofar as the functions carried out by the latter Bureau pertain to (A) regulation of radiation from consumer products, including electronic product radiation, (B) radiation as used in the healing arts, (C) occupational exposures to radiation, and (D) research, technical assistance, and training related to clauses (A), (B), and (C).

(4) The functions vested in the Secretary of Health, Education, and Welfare of establishing tolerances for pesticide chemicals under the Federal Food, Drug, and Cosmetic Act, as amended, 21 U.S.C. 346, 346a, and 348, together with authority, in connection with the functions transferred, (i) to monitor compliance with the tolerances and the effectiveness of surveillance and enforcement, and (ii) to provide technical assistance to the States and conduct research under the Federal Food, Drug, and Cosmetic Act, as amended, and the Public Health Service Act, as amended.

(5) So much of the functions of the Council on Environmental Quality under section 204(5) of the National Environmental Policy Act of 1969 (Public Law 91–190, approved January 1, 1970, 83 Stat. 855), as pertains to ecological systems.

(6) The functions of the Atomic Energy Commission under the Atomic Energy Act of 1954, as amended, administered through its Division of Radiation Protection Standards, to the extent that such functions of the Commission consist of establishing generally applicable environmental standards for the protection of the general environment from radioactive material. As used herein, standards mean limits on radiation exposures or levels, or concentrations or quantities of radioactive material, in the general environment outside the boundaries of locations under the control of persons possessing or using radioactive material.

(7) All functions of the Federal Radiation Council (42 U.S.C. 2021(h)).

(8) (i) The functions of the Secretary of Agriculture and the Department of Agriculture under the Federal Insecticide, Fungicide, and Rodenticide Act, as amended (7 U.S.C. 135–135k), (ii) the functions of the Secretary of Agriculture and the Department of Agriculture under section 408(*l*) of the Federal Food, Drug, and Cosmetic Act, as amended (21 U.S.C. 346a(*l*)), and (iii) the functions vested by law in the Secretary of Agriculture and the Department of Agriculture which are administered through the Environmental Quality Branch of the Plant Protection Division of the Agricultural Research Service.

(9) So much of the functions of the transferor officers and agencies referred to in or affected by the foregoing provisions of this section as is incidental to or necessary for the performance by or under the Administrator of the functions transferred by those provisions or relates primarily to those functions. The transfers to the Administrator made by this section shall be deemed to include the transfer of (1) authority, provided by law, to prescribe regulations relating primarily to the transferred functions, and (2) the functions vested in the Secretary of the Interior and the Secretary of Health, Education, and Welfare by section 169(d)(1)(B) and (3) of the Internal Revenue Code of 1954 (as enacted by section 704 of the Tax Reform Act of 1969, 83 Stat. 668); but shall be deemed to exclude the transfer of the functions of the Bureau of Reclamation under section 3(b)(1) of the Water Pollution Control Act (33 U.S.C. 466a(b)(1)).

(b) There are hereby transferred to the Agency:

(1) From the Department of the Interior, (i) the Water Pollution Control Advisory Board (33 U.S.C. 466f), together with its functions, and (ii) the hearing boards provided for in sections 10(c)(4) and 10(f) of the Federal Water Pollution Control Act, as amended (33 U.S.C. 466g(c)(4); 466g(f)). The functions of the Secretary of the Interior with respect to being or designating the Chairman of the Water Pollution Control Advisory Board are hereby transferred to the Administrator.

(2) From the Department of Health, Education, and Welfare, the Air Quality Advisory Board (42 U.S.C. 1857e), together with its functions. The functions of the Secretary of Health, Education, and Welfare with respect to being a member and the Chairman of that Board are hereby transferred to the Administrator.

SEC. 3. *Performance of transferred functions.* The Administrator may from time to time make such provisions as he shall deem appropriate authorizing the performance of any of the functions transferred to him by the provisions of this reorganization plan by any other officer, or by any organizational entity or employee, of the Agency.

SEC. 4. *Incidental transfers.* (a) So much of the personnel, property, records, and unexpended balances of appropriations, allocations, and other funds employed, used, held, available, or to be made available in connection with the functions transferred to the Administrator or the Agency by this reorganization plan as the Director of the Office of Management and Budget shall determine shall be transferred to the Agency at such time or times as the Director shall direct.

(b) Such further measures and dispositions as the Director of Office of Management and Budget shall deem to be necessary in order to effectuate the transfers referred to in subsection (a) of this section shall be carried out in such manner as he shall direct and by such agencies as he shall designate.

SEC. 5. *Interim officers.* (a) The President may authorize any person who immediately prior to the effective date of this reorganization plan held a position in the executive branch of the Government to act as Administrator until the office of Administrator is for the first time filled pursuant to the provisions of this reorganization plan or by recess appointment, as the case may be.

(b) The President may similarly authorize any such person to act as Deputy Administrator, authorize any such person to act as Assistant Administrator, and authorize any such person to act as the head of any principal constituent organizational entity of the Administration.

(c) The President may authorize any person who serves in an acting capacity under the foregoing provisions of this section to receive the compensation attached to the office in respect of which he so serves. Such compensation, if authorized, shall be in lieu of, but not in addition to, other compensation from the United States to which such person may be entitled.

SEC. 6. *Abolitions.* (a) Subject to the provisions of this reorganization plan, the following, exclusive of any functions, are hereby abolished:

(1) The Federal Water Quality Administration in the Department of the Interior (33 U.S.C. 466–1).

(2) The Federal Radiation Council (73 Stat. 690; 42 U.S.C. 2021(h)).

(b) Such provisions as may be necessary with respect to terminating any outstanding affairs shall be made by the Secretary of the Interior in the case of the Federal Water Quality Administration and by the Administrator of General Services in the case of the Federal Radiation Council.

SEC. 7. *Effective date.* The provisions of this reorganization plan shall take effect sixty days after the date they would take effect under 5 U.S.C. 906(a) in the absence of this section.

APPENDIX J

Message of the President Transmitting Reorganization Plan No. 4 of 1970, July 9, 1970

To the Congress of the United States:

I transmit herewith Reorganization Plan No. 4 of 1970, prepared in accordance with chapter 9 of title 5 of the United States Code. The plan would transfer to the Secretary of Commerce various functions relating to the oceans and atmosphere, including commercial fishery functions, and would establish a National Oceanic and Atmospheric Administration in the Department of Commerce. My reasons for transmitting this plan are stated in a more extended accompanying message.

After investigation, I have found and hereby declare that each reorganization included in Reorganization Plan No. 4 of 1970 is necessary to accomplish one or more of the purposes set forth in section 901(a) of title 5 of the United States Code. In particular, the plan is responsive to section 901(a)(1), "to promote the better execution of the laws, the more effective management of the executive branch and of its agencies and functions, and the expenditious administration of the public business;" and section 901(a)(3), "to increase the efficiency of the operations of the Government to the fullest extent practicable."

The reorganizations provided for in the plan make necessary the appointment and compensation of new officers as specified in section 2 of the plan. The rates of compensation fixed for these officers are comparable to those fixed for other officers in the executive branch who have similar responsibilities.

The reorganization plan should result in the more efficient operation of the Government. It is not practical, however, to itemize or aggregate the exact expenditure reductions which will result from this action.

RICHARD NIXON.

THE WHITE HOUSE.

REORGANIZATION PLAN NO. 4 OF 1970

Prepared by the President and transmitted to the Senate and the House of Representatives in Congress assembled, July 9, 1970, pursuant to the provisions of chapter 9 of title 5 of the United States Code

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

SECTION 1. *Transfers to Secretary of Commerce.* The following are hereby transferred to the Secretary of Commerce:

(a) All functions vested by law in the Bureau of Commercial Fisheries of the Department of the Interior or in its head, together with all functions vested by law in the Secretary of the Interior or the Department of the Interior which are administered through that Bureau or are primarily related to the Bureau, exclusive of functions with respect to (1) Great Lakes fishery research and activities related to the Great Lakes Fisheries Commission, (2) Missouri River Reservoir research, (3) the Gulf Breeze Biological Laboratory of the said Bureau at Gulf Breeze, Florida, and (4) Trans-Alaska pipeline investigations.

(b) The functions vested in the Secretary of the Interior by the Act of September 22, 1959 (Public Law 86–359, 73 Stat. 642, 16 U.S.C. 760e–760g; relating to migratory marine species of game fish).

(c) The functions vested by law in the Secretary of the Interior, or in the Department of the Interior or in any officer or instrumentality of that Department, which are administered through the Marine Minerals Technology Center of the Bureau of Mines.

(d) All functions vested in the National Science Foundation by the National Sea Grant College and Program Act of 1966 (80 Stat. 998), as amended (33 U.S.C. 1121 et seq.).

(e) Those functions vested in the Secretary of Defense or in any officer, employee, or organizational entity of the Department of Defense by the provision of Public Law 91–144, 83 Stat. 326, under the heading "Operation and maintenance, general" with respect to "surveys and charting of northern and northwestern lakes and connecting waters," or by other law, which come under the mission assigned as of July 1, 1969, to the United States Army Engineer District, Lake Survey, Corps of Engineers, Department of the Army and relate to (1) the conduct of hydrographic surveys of the Great Lakes and their outflow rivers, Lake Champlain, New York State Barge Canals, and the Minnesota-Ontario border lakes, and the compilation and publication of navigation charts, including recreational aspects, and the Great Lakes Pilot for the benefit and use of the public,

(2) the conception, planning, and conduct of basic research and development in the fields of water motion, water characteristics, water quantity, and ice and snow, and (3) the publication of data and the results of research projects in forms useful to the Corps of Engineers and the public, and the operation of a Regional Data Center for the collection, coordination, analysis, and the furnishing to interested agencies of data relating to water resources of the Great Lakes.

(f) So much of the functions of the transferor officers and agencies referred to in or affected by the foregoing provisions of this section as is incidental to or necessary for the performance by or under the Secretary of Commerce of the functions transferred by those provisions or relates primarily to those functions. The transfers to the Secretary of Commerce made by this section shall be deemed to include the transfer of authority, provided by law, to prescribe regulations relating primarily to the transferred functions.

SEC. 2. *Establishment of Administration.* (a) There is hereby established in the Department of Commerce an agency which shall be known as the National Oceanic and Atmospheric Administration, hereinafter referred to as the "Administration."

(b) There shall be at the head of the Administration the Administrator of the National Oceanic and Atmospheric Administration, hereinafter referred to as the "Administrator." The Administrator shall be appointed by the President, by and with the advice and consent of the Senate, and shall be compensated at the rate now or hereafter provided for Level III of the Executive Schedule Pay Rates (5 U.S.C. 5314).

(c) There shall be in the Administration a Deputy Administrator of the National Oceanic and Atmospheric Administration who shall be appointed by the President, by and with the advice and consent of the Senate, and shall be compensated at the rate now or hereafter provided for Level IV of the Executive Schedule Pay Rates (5 U.S.C. 5315). The Deputy Administrator shall perform such functions as the Administrator shall from time to time assign or delegate, and shall act as Administrator during the absence or disability of the Administrator or in the event of a vacancy in the office of Administrator.

(d) There shall be in the Administration an Associate Administrator of the National Oceanic and Atmospheric Administration who shall be appointed by the President, by and with the advice and consent of the Senate, and shall be compensated at the rate now or hereafter provided for Level V of the Executive Schedule Pay Rates (5 U.S.C. 5316). The Associate Administrator shall perform such functions as the Administrator shall from time to time assign or delegate, and shall act as

Administrator during the absence or disability of the Administrator and Deputy Administrator. The office of Associate Administrator may be filled at the discretion of the President by appointment (by and with the advice and consent of the Senate) from the active list of commissioned officers of the Administration in which case the appointment shall create a vacancy on the active list and while holding the office of Associate Administrator the officer shall have rank, pay, and allowances not exceeding those of a vice admiral.

(e) There shall be in the Administration three additional officers who shall perform such functions as the Administrator shall from time to time assign or delegate. Each such officer shall be appointed by the Secretary, subject to the approval of the President, under the classified civil service, shall have such title as the Secretary shall from time to time determine, and shall receive compensation at the rate now or hereafter provided for Level V of the Executive Schedule Pay Rates (5 U.S.C. 5316).

(f) The President may appoint in the Administration, by and with the advice and consent of the Senate, two commissioned officers to serve at any one time as the designated heads of two principal constituent organizational entities of the Administration, or the President may designate one such officer as the head of such an organizational entity and the other as the head of the commissioned corps of the Administration. Any such designation shall create a vacancy in the active list and the officer while serving under this subsection shall have the rank, pay, and allowances of a rear admiral (upper half).

(g) Any commissioned officer of the Administration who has served under (d) or (f) and is retired while so serving or is retired after the completion of such service while serving in a lower rank or grade, shall be retired with the rank, pay, and allowances authorized by law for the highest grade and rank held by him; but any such officer, upon termination of his appointment in a rank above that of captain, shall, unless appointed or assigned to some other position for which a higher rank or grade is provided, revert to the grade and number he would have occupied had he not served in a rank above that of captain and such officer shall be an extra number in that grade.

SEC. 3. *Performance of transferred functions.* The provisions of sections 2 and 4 of Reorganization Plan No. 5 of 1950 (64 Stat. 1263) shall be applicable to the functions transferred hereunder to the Secretary of Commerce.

SEC. 4. *Incidental transfers.* (a) So much of the personnel, property, records, and unexpended balances of appropriations, allocations, and other funds employed, used, held, available, or to be made available in connection with the functions transferred to the Secretary of Commerce by this reorganization plan as the Director of the Office of Management and Budget shall determine shall be transferred to the Department of Commerce at such time or times as the Director shall direct.

(b) Such further measures and dispositions as the Director of the Office of Management and Budget shall deem to be necessary in order to effectuate the transfers referred to in subsection (a) of this section shall be carried out in such manner as he shall direct and by such agencies as he shall designate.

(c) The personnel, property, records, and unexpended balances of appropriations, allocations, and other funds of the Environmental Science Services Administration shall become personnel, property, records, and unexpended balances of the National Oceanic and Atmospheric Administration or of such other organizational entity or entities of the Department of Commerce as the Secretary of Commerce shall determine.

(d) The Commissioned Officer Corps of the Environmental Science Services Administration shall become the Commissioned Officer Corps of the National Oceanic and Atmospheric Administration. Members of the Corps, including these appointed hereafter, shall be entitled to all rights, privileges, and benefits heretofore available under any law to commissioned officers of the Environmental Science Services Administration, including those rights, privileges, any benefits heretofore accorded by law to commissioned officers of the former Coast and Geodetic Survey.

(e) Any personnel, property, records, and unexpended balances of appropriations, allocations, and other funds of the Bureau of Commercial Fisheries not otherwise transferred shall become personnel, property, records, and unexpended balances of such organizational entity or entities of the Department of the Interior as the Secretary of the Interior shall determine.

SEC. 5. *Interim officers* (a) The President may authorize any person who immediately prior to the effective date of this reorganization plan held a position in the executive branch of the Government to act as Administrator until the office of Administrator is for the first time filled pursuant to provisions of this reorganization plan or by recess appointment, as the case may be.

(b) The President may similarly authorize any such person to act as Deputy Administrator and authorize any such person to act as Associate Administrator.

(c) The President may similarly authorize a member of the former Commissioned Officer Corps of the Environmental Science Services Administration to act as the head of one principal constituent organizational entity of the Administration.

(d) The President may authorize any person who serves in an acting capacity under the foregoing provisions of this section to receive the compensation attached to the office in respect of which he so serves. Such compensation, if authorized, shall be in lieu of, but not in addition to, other compensation from the United States to which such person may be entitled.

SEC. 6. *Abolitions.* (a) Subject to the provisions of this reorganization plan, the following, exclusive of any functions, are hereby abolished:

(1) The Environmental Science Services Administration in the Department of Commerce (established by Reorganization Plan No. 2 of 1965, 79 Stat. 1318), including the offices of Administrator of the Environmental Science Services Administration and Deputy Administrator of the Environmental Science Services Administration.

(2) The Bureau of Commercial Fisheries in the Department of the Interior (16 U.S.C. 742b), including the office of Director of the Bureau of Commercial Fisheries.

(b) Such provisions as may be necessary with respect to terminating any outstanding affairs shall be made by the Secretary of Commerce in the case of the Environmental Science Services Administration and by the Secretary of the Interior in the case of the Bureau of Commercial Fisheries.

APPENDIX K

Budget Analysis

TABLE 1.—*Estimated Federal Funding for Pollution Control and Abatement Programs, Fiscal Years 1969, 1970, 1971 by Type of Activity*

[In millions of dollars]

Type of activity	Budget authority			Obligations			Outlays		
	1969	1970	1971	1969	1970	1971	1969	1970	1971
I. Assistance for State, interstate, and local governments [1]	289	887	4, 089	312	626	1, 336	217	255	649
a. Funds for capital investments; e.g., treatment facilities	232	825	4, 020	256	564	1, 265	170	199	580
b. Funds for operations of pollution control agencies	36	39	45	35	39	46	25	35	45
c. Technical assistance	21	23	25	21	23	25	22	21	24
II. Research, development, and demonstration [1]	319	319	346	330	332	361	292	317	339
a. Primarily for pollution control and abatement	249	241	267	253	251	277	220	242	259
b. For some other primary purpose but contributing to pollution control and abatement	70	78	79	77	81	84	72	75	80
III. Monitoring and surveillance [1]	49	46	50	48	46	51	48	46	51
a. Primarily for pollution control and abatement	41	38	40	40	38	41	40	38	41
b. For some other primary purpose but contributing to pollution control and abatement	8	8	10	8	8	10	8	8	10
IV. Standards promulgation and enforcement	23	27	32	22	28	32	22	26	31
V. Manpower development	17	18	19	16	18	19	17	17	18
VI. Remedial actions to control pollution at Federal facilities	50	88	130	77	108	153	63	103	144
VII. Other:									
a. Program administration and education	25	31	30	22	29	30	19	20	33
b. Direct actions by AEC to control pollution from radioactive wastes	22	29	37	22	30	38	19	26	32
c. Financial and technical assistance by Soil Conservation Service to control sediment and agriculturally related pollutants	68	75	79	68	75	79	66	75	83
Total	862	1, 520	4, 813	916	1, 291	2, 100	763	885	1, 380

[1] Totals of amounts below.

NOTE.—Details in the tables may not add exactly to the totals due to rounding.

Source: Compiled from data supplied by the Office of Management and Budget, July 1970.

TABLE 2.—*Estimated Federal Funding for Pollution Control and Abatement, by Agency and by Polluted Medium and Selected Pollutants (Fiscal Year 1970 Obligations)*

[In millions of dollars]

Agency	Polluted medium			Selected pollutants [1]						
	Air	Water	Land	Pesticides	Radiation	Solid wastes	Noise	Thermal	Other	Total
Interior	4. 0	629. 9	2. 6	5. 2	0. 2	5. 7	....	2. 4	....	650. 0
AEC	4. 6	5. 8	. 2	. 1	133. 3	2. 1	....	1. 8	....	147. 9
HEW	94. 2	3. 5	....	11. 7	18. 6	15. 2	0. 1	....	7. 9	151. 2
DOD-military	19. 9	35. 5	....	. 7	. 8	. 2	12. 5	....	. 1	69. 7
Agriculture	12. 0	120. 7	7. 9	23. 2	. 7	2. 6	....	....	. 4	167. 5
Transportation	5. 8	6. 0	....	. 2	....	. 4	7. 3	....	....	19. 7
NASA	2. 3	. 9	....	....	....	. 1	14. 0	....	....	17. 3
Appalachian Regional Commission	....	4. 6	6. 5	....	....	1. 0	....	....	....	12. 1
TVA	14. 5	10. 2	. 1	....	1. 4	. 1	....	6. 8	....	33. 1
Corps of Engineers	. 4	3. 0	....	....	....	1. 8	....	....	....	5. 2
Commerce	1. 7	3. 4	. 2	....	. 1	. 2	. 2	....	. 4	6. 2
Justice	. 3	....	....	....	....	. 9	....	....	....	1. 2
Other	3. 5	5. 0	. 2	. 1	. 2	. 4	....	....	. 4	9. 8
Total	163. 2	828. 5	17. 7	41. 2	155. 3	30. 0	34. 1	11. 0	9. 2	1, 290. 9

[1] Excluding funds reported in media columns.

Source: Compiled from data supplied by the Office of Management and Budget, July 1970.

TABLE 3.—*Estimated Federal Funding (Fiscal Year 1970 Obligations) for Pollution Control and Abatement, by Agency and by Type of Activity*

[In millions of dollars]

Agency	Aid to State, regional, and local governments				Research, development demonstration			Monitoring and surveillance			Standards and enforcement	Manpower development	Pollution control: Remedial actions at Federal facilities	Other			Grand total
	Capital funds	Operating funds	Technical assistance	Subtotal	Primarily for pollution control	Contributing to pollution control	Subtotal	Primarily for pollution control	Contributing to pollution control	Subtotal				Program administration and education	AEC control of radioactive wastes	Financial-technical assistance by SCS	
Interior	514. 8	12. 5	11. 4	538. 7	57. 4	16. 2	73. 6	4. 4	5. 5	9. 9	4. 4	6. 2	7. 6	9. 8			650. 0
AEC			. 1	. 1	71. 2	17. 1	88. 3	15. 9		15. 9	11. 7		1. 5		30. 4		147. 9
HEW		26. 7	10. 6	37. 3	62. 8	7. 0	69. 8	10. 0	1. 0	11. 0	7. 4	11. 1		13. 9			150. 4
DOD-military					. 5	6. 5	7. 0	4. 6	. 3	4. 9		. 4	57. 8	. 1			70. 1
Agriculture	32. 3			32. 3	32. 8	17. 7	50. 5	. 7	1. 2	1. 9	3. 2		3. 1	1. 2		75. 1	167. 2
TVA			. 3	. 3	. 8	3. 6	4. 4	1. 5		1. 5			26. 9				33. 1
Transportation					9. 4	7. 1	16. 5				. 9		. 5	1. 8			19. 7
NASA					14. 1	3. 1	17. 2						. 1				17. 3
Appalachian Regional Commission	10. 4			10. 4										1. 8			12. 1
Commerce	2. 3		. 4	2. 7	. 5	2. 7	3. 2	. 2	. 2	. 4			. 2				6. 5
Corps of Engineers								1. 0		1. 0			4. 2				5. 2
GSA													2. 3				2. 3
HUD	2. 5			2. 5													2. 5
VA													1. 8				1. 8
Post Office					. 2		. 2						1. 4				1. 6
Justice	. 5			. 5									. 7				1. 2
State	. 8			. 8					. 1	. 1	. 1						1. 0
NSF					. 8		. 8										. 8
Smithsonian						. 2	. 2										. 2
Total	563. 5	39. 2	22. 8	625. 5	250. 5	81. 0	331. 5	38. 3	8. 1	46. 4	27. 7	17. 7	108. 1	28. 5	30. 4	75. 1	1, 290. 9

Source: Compiled from data supplied by the Office of Management and Budget, July 1970.

TABLE 4.—*Estimated Federal Funding (Fiscal Year 1970 Obligations) for Other Environmentally Related Activities, by Agency and by Selected Activities*

[In millions of dollars]

Agency	Preventing side effects [1] [2]		Enhancing the environment [1] [3]			Weather modification	Understanding, describing, predicting the environment [4]				Population control and distribution	Management of public lands	Environmental health	Environmental education	Pest control	Water, sewer grants, loans	Agriculture conservation program	Major civilian technology and development programs [1]
	A	B	A	B	C		A	B	C	D								
Interior	18.0	8.2	221.5	106.7		4.8	1.4	90.5		4.3		170.3	0.6	1.5	0.5	2.4		11.6
Agriculture	203.1	20.5	90.0	9.8	13.1	.5	1.0	29.6		4.6	0.3	16.7	175.5	23.9	60.5	138.1	233.1	
DOT		227.0	13.0		146.2		19.1				.2							72.5
DOD				1.0	1.8	.2	237.2					24.1	20.8		2.7			
HEW									21.7		64.2		22.1	11.2	16.1			
Corps of Engineers		82.8	65.2		3.6		5.3											
HUD	.4		60.6		15.4				3.4		2.5			1.1		185.4		
Commerce			12.5	.1		1.4	130.0									63.4		
NSF						2.5	15.6	10.9	8.0	65.8	1.0		.4	2.9	.1			
OEO			4.9		55.0		46.7				22.0		.5					
NASA								30.4										
Smithsonian							1.0	2.4	1.7	3.5				7.7				
TVA	3.2	1.3	4.4	.3									2.6					
Appalachian Regional Commission	1.8		.1								.1					1.5		
Labor													3.4					
AEC	49.8																	203.4
FPC	.5											.1						
Total	276.8	339.8	472.2	117.9	235.1	9.4	457.3	163.8	34.8	78.2	90.3	211.2	225.9	48.3	79.9	390.8	233.1	287.5

[1] Projects which have an environmental or natural resource conservation impact but are primarily for some other purpose.

[2] Preventing, controlling, or correcting environmental degradation (i.e., side effects caused by: A. Non-Federal natural resource exploitation activities. B. Direct Federal public works activities and public works activities supported by the Federal Government under grants or loans.

[3] Enhancing the environment: A. Recreation resources. B. Fisheries and Wildlife preservation. C. "Natural Beauty"; e.g., highway beautification activities.

[4] Understanding, describing, predicting the environment: A. Environmental observation and measurement for the purpose of describing and predicting weather and ocean activities. B. Locating and describing natural resources. C. Research on the impact of the environment on man. D. Ecology and other basic environmental research.

Source: Compiled from data supplied by the Office of Management and Budget, July 1970.

APPENDIX L

Organization and Staff of the Council on Environmental Quality

THE COUNCIL

On January 29, 1970, the President nominated Russell E. Train, Chairman, and Robert Cahn and Gordon J. F. MacDonald, members, of the Council on Environmental Quality, Executive Office of the President. They were confirmed by the Senate on February 6.

Mr. Train was formerly Under Secretary of the Interior. From 1965 to 1969 he was president of The Conservation Foundation, and has been active in a number of other conservation organizations, both here and abroad. He served on the staffs of congressional committees, and headed the Treasury Department's tax legislative staff before being appointed to the Tax Court of the United States, where he served for eight years. Following the 1968 election, President-elect Nixon appointed him chairman of a special task force on environmental problems.

Mr. Cahn is on leave from the Washington Bureau of The Christian Science Monitor, for which he has been a correspondent since 1965. He was awarded the 1969 Pulitzer Prize for National Reporting for his series of articles on national parks. He has been a reporter for the Seattle Star, the Pasadena Star-News, and Life magazine; an editor of Collier's and the Saturday Evening Post; and the White House correspondent for the U.S. Information Agency.

Dr. MacDonald is on leave from the University of California at Santa Barbara, where he has been vice chancellor for research and graduate affairs since September 1968. He was a member of the President's Science Advisory Committee, 1965–69. For the National Academy of Sciences, he served on the Committee on Atmospheric Sciences, 1961–70; the Space Science Board, 1962–70; and the Environmental Studies Board, 1968–70, part of which period he was the Board's chairman. He also has been chairman of the Executive Committee of the Earth Sciences Division of the National Research Council.

Professional Staff

Boyd H. Gibbons III, is Secretary of the Council, in charge of primary staff support activities as well as the Council's liaison with Government agencies, private groups, and State and local governments. He served as Deputy Under Secretary of the Interior and before that was legislative assistant to Senator Paul J. Fannin, of Arizona.

Timothy Atkeson, General Counsel, is responsible for review of legislative and regulatory matters coming before the Council. Formerly a partner in the Washington law firm of Steptoe & Johnson, he more recently was General Counsel of the Asian Development Bank.

Alvin L. Alm is Senior Staff Member for Environmental Pollution, responsible for coordinating Council staff review of pollution programs and issues. He was previously the Bureau of the Budget's examiner for water pollution and water resource development programs.

Dr. Lee M. Talbot, Senior Scientist, on leave from the Smithsonian Institution, where he is Resident Ecologist. He has directed a number of ecological research and environmental assessment projects in various parts of the world, is co-author of five books, and has published about 120 scientific articles.

Dr. J. Clarence Davies III, formerly Assistant Professor of Politics and Public Affairs, Princeton University. From 1965 to 1967 he was with the Bureau of the Budget, with primary responsibility for pollution control and consumer protection programs.

Heyward Isham, on detail from the Department of State. He has been in the Foreign Service since 1948 and for the past year has been at Harvard University on a fellowship.

Charles F. Lettow, formerly an assistant to Supreme Court Chief Justice Warren Burger.

William T. Lake, formerly an assistant to Supreme Court Justice John M. Harlan.

William Matuszeski, formerly special assistant to the Director, U.S. Information Agency.

William K. Reilly, formerly Associate Director, Urban Policy Center, Urban Coalition.

Dr. Thomas C. Winter, Jr., Lt. Col., U.S. Army, physicist. He is on assignment from the Army Corps of Engineers.

Eric R. Zausner, formerly Chief, Management Sciences Section, Bureau Solid Waste Management, Department of Health, Education, and Welfare.

Russell W. Cahill, a biologist and former National Park Ranger, Glacier Bay, Alaska, on detail from the National Park Service.

Mary Sperling McAuliffe, research assistant.

Gail A. Boyer, research assistant.

Administrative Staff

Willis G. Savage is Administrative Officer; Sylvia Grace Reppert, Assistant Administrative Officer; and Dorothy A. Gooding, Administrative Assistant. Marian L. O'Connell is Executive Assistant to the Chairman, and Marjory D. Bianchi and Mary C. Curran are Executive Assistants to Mr. Cahn and Dr. MacDonald, respectively. Julia Alessio, Olga S. Chemerys, Barbara N. Gray, N. Jayne Parker, and Bonita M. Van Tassel are Secretaries, and Thomas Walker is Messenger-Driver.

Interns for the summer of 1970 are Karen L. Buxbaum, Jackson College, Tufts University, Medford, Mass.; Jeffrey R. Clark, Trinity College, Hartford, Conn.; Susan C. Cottingham, Mary Washington College, Fredericksburg, Va.; Joseph W. Creekmore III, William and Mary College, Williamsburg, Va.; Nancy K. Hetzel, B.A., Purdue University, M.A., The Johns Hopkins University School of Advanced International Studies, and Fulbright Fellow, Institute of International Studies, Geneva, Switzerland, 1970–71; Noralyn Olom, Vassar College; James W. Spensley, George Washington University Law School; Joyce Tannenbaum, B.S., University of Maryland; and David R. Yesner, Cornell University.

Annual Report Staff

To assist the Council in preparing the First Annual Report, an ad hoc editorial staff was assembled. Odom Fanning of the Department of Commerce was director, Bill L. Long of the National Council on Marine Resources and Engineering Development deputy director, and Sheila A. Mulvihill of the Smithsonian Institution assistant director. Editors were Walter Froehlich, U.S. Information Agency, and Van

Vechten Trumbull, Department of Health, Education, and Welfare. F. R. Anderson, National Academy of Engineering, and John C. Waugh were editorial consultants. J. D. Stewart, Government Printing Office, was printing consultant. Secretaries, loaned by the Department of the Interior, were Pauline Dawson, Joyce Dovine, and Dorothy M. Keller.

A Note of Appreciation

The Council expresses its appreciation to all the agencies named above for making available the services of so many persons. Those assisting, on detail, deserve special thanks. In connection with the annual report, the Council is grateful to the scores of others in various agencies who contributed by supplying information and checking draft materials.

☆ U.S. GOVERNMENT PRINTING OFFICE : 1970 O—389-110